Priorities for crash countermeasures in Australia and New Zealand – an overview based on Safe Systems principles

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Abstract

This work was part of a project to provide information on key fatal and serious crash types across Australia and New Zealand, and to benchmark safety performance of different road stereotypes between jurisdictions. The entire dataset of casualty crashes occurring in Australia and New Zealand from 2001 to 2010 was assembled. So far as possible, differences between the different data sets were reconciled to create a single database for Australia and another for New Zealand. Where this was not possible, those jurisdictions which could not be reconciled with the overall classification were omitted from that part of the analysis. In line with Safe System principles, results were presented as fatal and serious injury crashes contrasted with all casualty crashes, generating some important insights for crash countermeasure priorities. Some types of crash had large proportions of fatal and serious injury crashes, while other types of crash had relatively small percentages of these crashes but such high overall frequencies that they accounted for a large proportion of the fatal and serious injury crashes. Key crash types for Australia were off-path, head-on, adjacent approaches, and same direction crashes, and for New Zealand the key crash types were loss-of-control on curve, crossing/turning, loss-of-control on a straight, and rear-end/ obstruction. In Australia, the largest number of fatal and serious injury crashes occurred on urban arterial roads; while in New Zealand, the greatest number occurred on rural roads. Plans for further analyses in terms of crash rates for benchmarking will be described in the paper.

Introduction

The issue

Safe System principles aim to ensure that no individual is killed or permanently impaired as a result of a traffic collision, which leads to a focus on eliminating the possibility of road fatalities and serious injuries (FSI). Until now, Australia has had no single crash database that holds casualty crash data for all jurisdictions. There was a fatal crash database at the national level, but other data were only held within individual jurisdictions. More recently, the Bureau for Infrastructure, Transport and Regional Economics (BITRE) developed the National Crash Database (NCD), which includes both fatal and injury crashes. Since the NCD focusses on indicators for National Road Safety Strategy (NRSS) performance monitoring, it contains a reduced set of variables (i.e. fewer than those available on jurisdiction-based databases) and a smaller period of coverage (personal communication, Tim Risbey, BITRE, June 2013).

As a result, there is no document that provides comprehensive analysis of crash factors by injury level in Australia. For this reason, planning at the national level and comparisons between jurisdictions has been difficult.

The project

This paper reports selected outcomes of the first year of an Austroads project ST 1763, Crash Analysis – Australian and New Zealand data. The project has the aims of establishing crash rates for different road stereotypes across Australia's state road networks and New Zealand's national network. The work reported in this paper is an aggregation of all fatalities and serious injuries resulting from the different types of road crashes in Australia and New Zealand.

Method

Data sources and checking

The analysis is based on data provided by each road agency in Australia and New Zealand. Most data is obtained from police reports of crashes, although some jurisdictions also accept reports from members of the public. Police report forms and road agency coding methods differ between jurisdictions, as does the proportion of crashes attended by police. Consequently, there are many differences between datasets, both in terms of detail and accuracy. Serious injury is generally defined by hospital admittance or attendance.

Collection and checking of crash data from each jurisdiction was a complex task that required substantial time to complete. Issues related to file compatibility, file size and required processing time, missing data and the need for checking and re-checking all contributed to this. The data checking process is described in the project report (Bradshaw et al. 2014).

Data aggregation

Data from each jurisdiction were imported into SPSS. Tabulated data were then exported to Excel where data from each jurisdiction were combined, and graphs and tables created. Aggregating data across all road agencies presented two main challenges. The first was reconciling the different definitions of crash types used in different jurisdictions. In some cases this was a straightforward matter; in other cases, there were considerable differences in the approach to classifying classes of crash types. The approach adopted involved simplifying the number of categories and allocating particular crash types to the new wider range of crash types. A full account of how this was achieved is included in the full report (Bradshaw et al. 2014). Despite these efforts, the classification used in New Zealand was just too different to be accommodated, so New Zealand results are presented separately throughout the document.

The second major challenge was that the injury severity definition used by New South Wales did not distinguish between serious injuries and other injuries. The number of serious and other injuries occurring in New South Wales was estimated from weighted averages derived from the casualty crash data for other Australian jurisdictions. However, in the case of total injury numbers, existing estimations provided by The Centre for Road Safety, Transport for NSW were used.

Other lesser issues that limit the precision with which results can be compared across jurisdictions include differences in: methods for classifying roads as urban or rural, inclusion of private roads, car parks, etc., extent to which speed limit is recorded, road characteristics, heavy vehicle characteristics, classification of road function, state or local government road, and definitions of intersection crashes.

Key Results

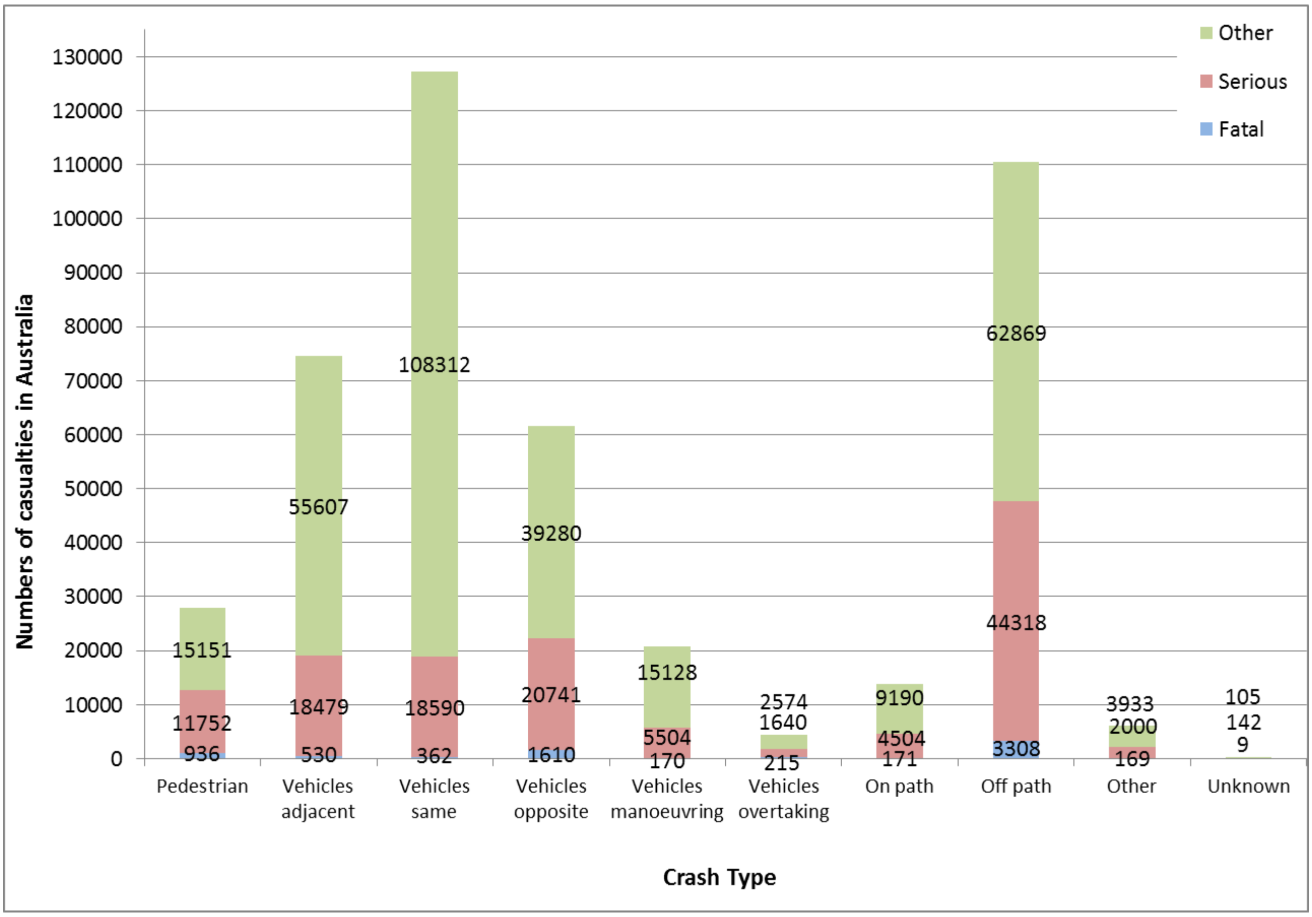
A comprehensive breakdown of the results is available in the full report of the analysis (Bradshaw et al. in press). The results reported here have been selected to illustrate key points of the analysis or highlight priorities for countermeasures. While these are not exactly new findings, they may provide a clearer indication for priorities than has previously been the case.

The analysis was conducted on all FSI recorded by road agencies in Australia and New Zealand over the period 200-2010. The average number of fatalities and serious injuries per year were 1,496 and 24,292 in Australia, and 388 and 2,555 in New Zealand. Both fatalities and serious injuries declined over the period; in the last year of the study (2010) the fatalities and serious injuries for Australia were 1,352 and 22, 187 for Australia and 375 and 2,316 for New Zealand.

Effects of focussing on killed and serious injuries

One of the main reasons for undertaking the study was to obtain a clearer picture of the incidence of serious injuries and their circumstances across the two nations. The difference in perspective is shown clearly in Figures 1-4.

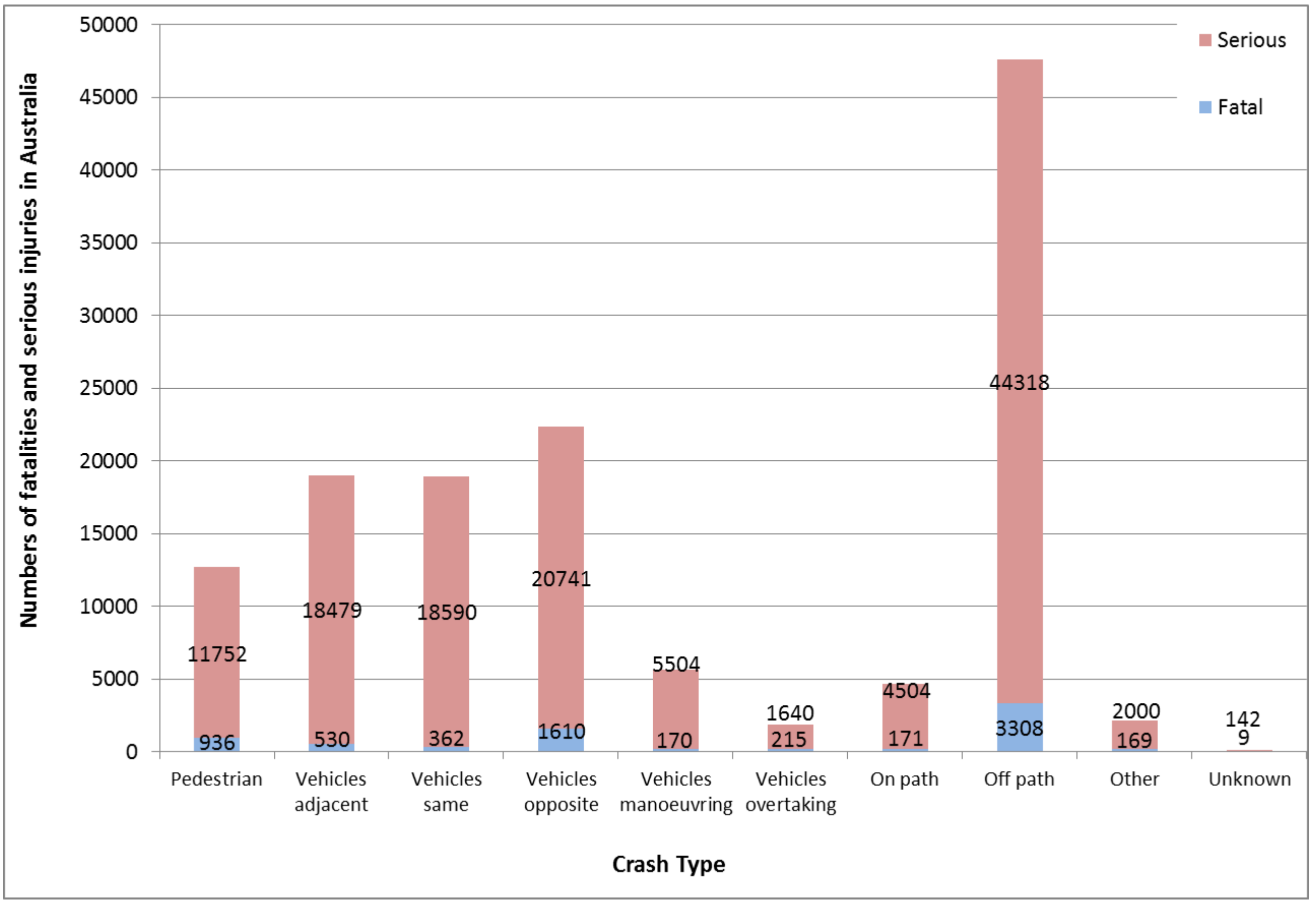
Comparing the data from Australia in Figures 1 and 2, when only FSI are considered, off-path crashes stand out as by far the most frequent event, followed by vehicles travelling in opposite directions (i.e. head-on crashes and side-swipes). Vehicles approaching from adjacent directions and vehicles travelling in the same direction are approximately the same (although fatalities are much higher for adjacent directions), followed by pedestrians.



Notes: Serious and other injury data estimated for NSW; for QLD, the available data for other injuries was from 1 July 2005 to 30 June 2010; SA did not collect data for categories 'Vehicles manoeuvring' or 'Vehicles over-taking'.

Figure 1: Casualties in Australia by crash movement type, 2006–10

The results from New Zealand (Figures 3 and 4) also show substantial differences in the magnitude of the change when only FSI are considered, but the order of the types of event is substantially unchanged, with the 'rear end category' (equivalent to Australia's 'same direction' category) going down one place and the 'straight, lost control' category moving up one. Nevertheless, the extent to which the 'bend, lost control' category overshadows other crash types is similar to Australia's 'off-path' category.



Notes: Serious and other injury data estimated for NSW; for QLD, the available data for other injuries was from 1 July 2005 to 30 June 2010.

Figure 2: Fatal and serious injuries in Australia by crash movement type, 2006–10

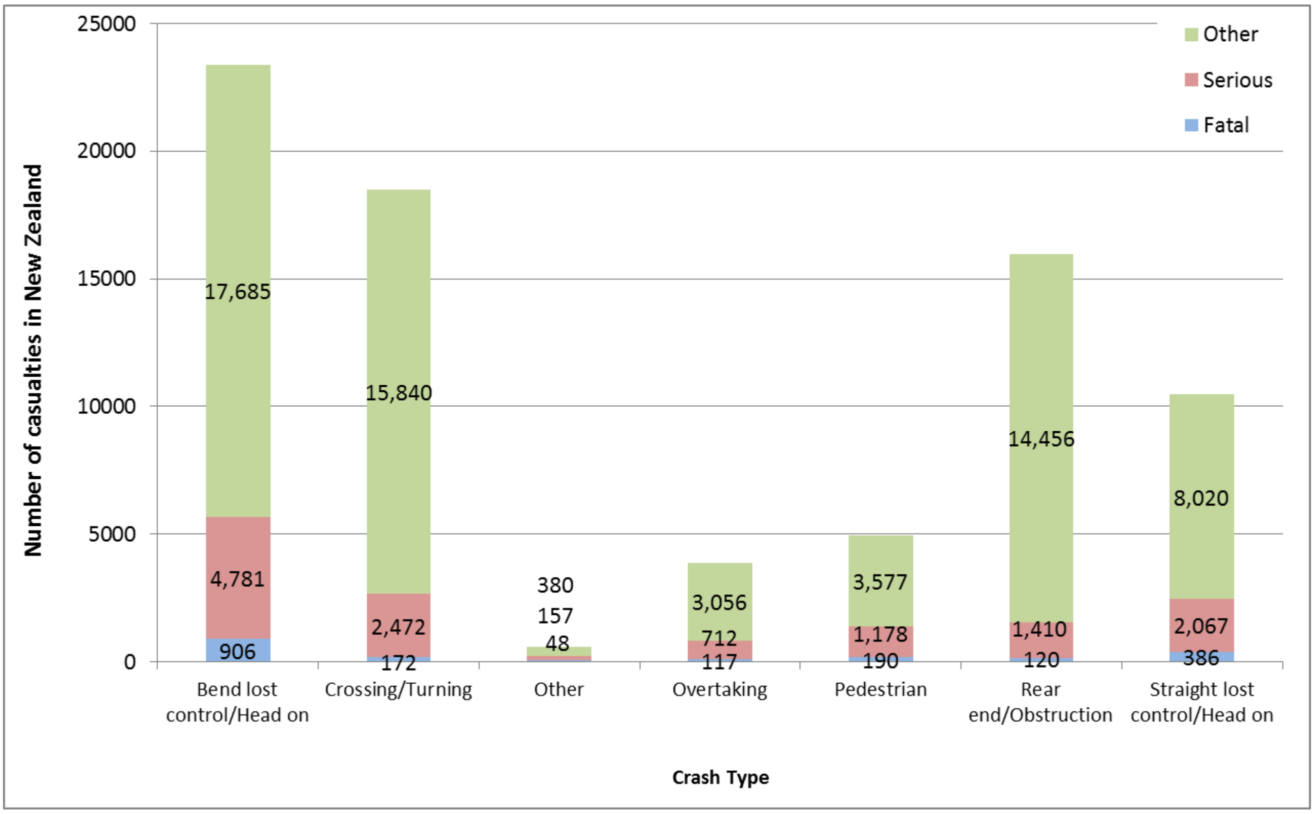


Figure 3: Casualties in New Zealand by crash movement type, 2006–10

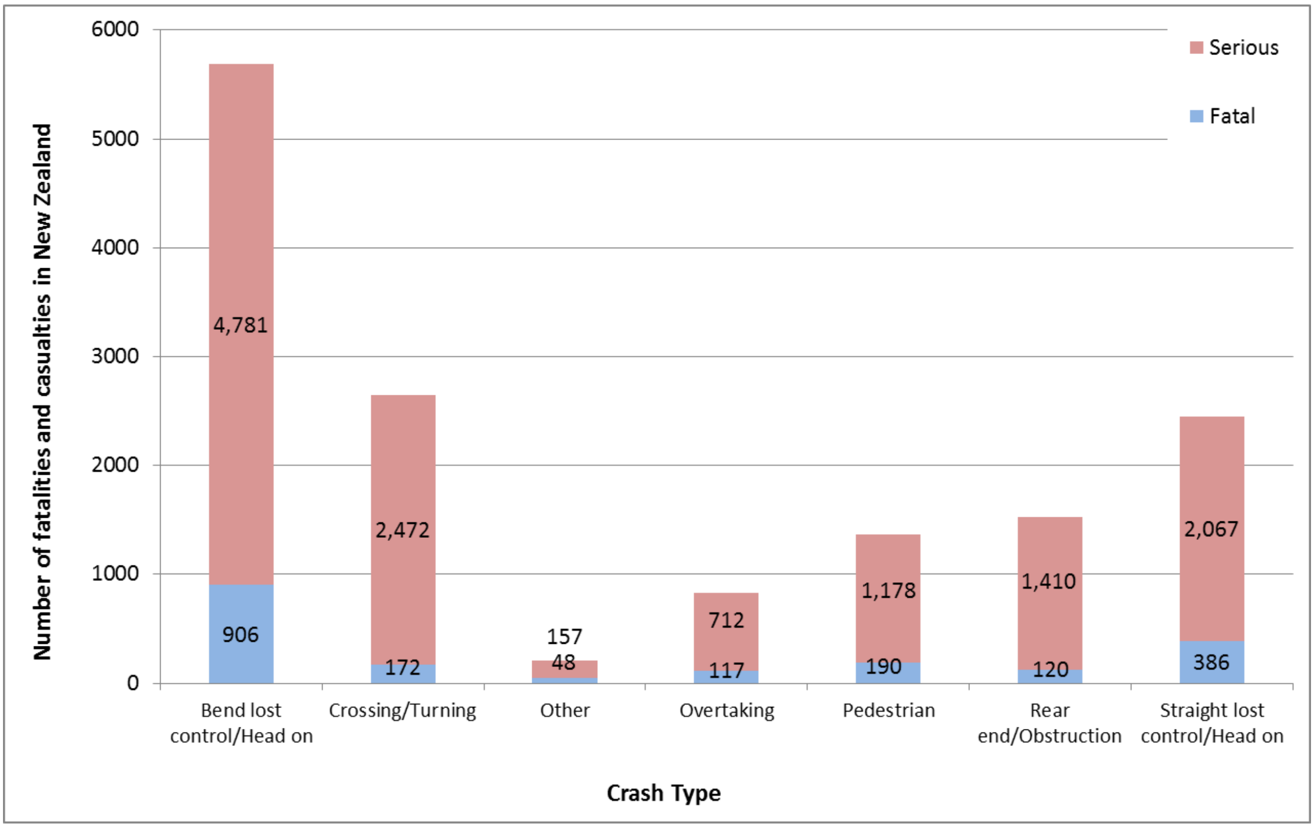


Figure 4: Fatalities and serious injuries in New Zealand by crash movement type, 2006–10

Key crash types in Australia

The number and percentage of fatalities and serious injuries in Australia is shown in Table 1. Note that these four crash types account for 80% of the fatalities and serious injuries. The off-path category predominates, accounting for over one third of FSI. It is followed by the head-on category with 17% of FSI, then the adjacent approaches category and the same direction category with a further 14% each. These four categories account for 80% of FSI.

Table 1:. Numbers and percentages of the principal crash types, Australia 2005-2010

Crash type	Number (%) FSI casualties
off-path	47,626 (35%)
head-on	22,351 (17%)
adjacent approaches	19,009 (14%)
same direction crashes	18,952 (14%)
other	27,149 (20%)
total	135.087 (100%)

Key crash types in New Zealand

Off path events also appear to be important in New Zealand, with loss of control on curve being the most frequent type of event, and loss of control on straight also being a major contributor. Crossing/turning (equivalent to the Australian adjacent directions category) is the second most frequent category. Rear-end crashes account for a further 10% of crashes. In this case, the four top categories account for 79% of FSI.

Table 2: Numbers and percentages of the principal crash types, New Zealand 2005-2010

Crash type	Number (%) FSI casualties
loss-of-control on curve	4,687 (33%)
crossing/turning	2,644 (18%)
loss-of-control on a straight	2,453 (17%)
rear-end/ obstruction	1,539 (11%)
other	3,093 (21%)
total	14,416 (100%)

The same-direction category is of particularly worthy of note. This is a type of crash that has not been a high priority in terms of Safe Systems thinking, as the various types of rear-end crash that make up this category usually occur at low speed, and vehicle occupants are generally well-protected by the vehicle's structure. However, they are a very frequent occurrence. Figure 1 shows that they are the most frequent type of injury crash in Australia when all severities are considered, although they do not predominate to the same extent in New Zealand (Figure 3). Despite their relatively low average severity, the high frequency of same direction collisions means that they are one of the major sources of FSI.

Rural vs Urban Crashes

When all categories of severity are considered, in both Australia and New Zealand most casualties occur on urban roads. However, when only KSI are considered (Table 3), there are differences between the two countries, with FSI being more evenly split between rural and urban roads in New Zealand than in Australia. In Australia, the proportion of FSI occurring on urban roads is higher than the proportion occurring on rural roads, while in New Zealand the proportion of FSI occurring on rural roads is higher than the proportion occurring on urban roads.

Table 3: Percentage of crashes on rural or urban roads in Australia and New Zealand 2005-2010

	Australia	New Zealand
rural	38%	55%
urban	62%	45%

Discussion

Implications for Safe System priorities

The implications for Safe System priorities are clear. The greatest safety gains are likely to be made in both countries by measures to prevent collisions or maintain impact forces within road users' biomechanical tolerances in three situations:

- keeping vehicles travelling in their own lane and preventing them from straying off the road way or into opposing lanes
- vehicles crossing one another's paths.
- vehicles running into the back of other vehicles.

In both Australia and New Zealand, the fifth most frequent category of FSI was pedestrians. Some of the technologies to address the second and third issues may also benefit pedestrians; the potential benefits to pedestrians would provide substantial additional justification for these measures.

Other limitations

Other limitations of the study not so far discussed include:

- under-reporting and varying reporting rates. Reporting rates are likely to vary by jurisdiction, to decline with remoteness within jurisdiction, and to be influenced by road type and road user type, with under-reporting particularly prevalent amongst motorcyclists, bicyclists and pedestrians
- incompatibility and missing data
- exposure data is missing (this includes information on population, traffic and other variables. This information is required to make sense of some of the results provided. This issue will be addressed in future components of this project)
- further cross-tabulations are required (more detailed analysis will help provide a greater understanding of crash risks).

Potential applications

The creation of the data base represents a considerable investment, but the result has been the creation of a resource that will not only allow the project objectives to be achieved in terms of benchmarking the performance of the different road stereotypes across Australia and New Zealand and against overseas practice, but which may be of considerable value for Austroads projects and other research of national significance.

In particular, it is anticipated that the database will be crucial for the validation and further development of the Australian National Risk Assessment Model (ANRAM). The availability of the comprehensive crash data base with geocodes linked to the crash information is likely to prove a useful tool for comparing the crash histories of sites with their ANRAM scores. Investigation of mismatches between ANRAM and crash history is likely to be a rich source of information which will assist in the calibration and refinement of the model.

Next steps

Work is progressing with the determination of crash rates for all links on the road network operated by Australian road agencies. Except in cases where the agency has already completed similar work, this entails matching traffic estimates with crash records and calculating the rate in terms of fatalities per kilometre travelled and serious injury per km travelled. This work is now well advanced, but is not expected to be complete until late 2015. The rates data will be used to create Safety Performance Functions (i.e. functions that relate traffic flow to numbers of crashes or crash rates) for the different road stereotypes.

The relatively long time lag between start of the study period and the results becoming available (imposed in part by the need to accumulate data over several years to generate estimates with acceptable confidence intervals on the less frequent road stereotypes) is of less concern for studies of crash rates on different road stereotypes than it would be for many other types of investigation. The road system changes relatively slowly in comparison to the vehicle fleet, which is constantly expanding and being renewed, or to road user behaviour which is subject to changes in the age structure of the population and influence by enforcement and publicity.

Work is also under way to benchmark Australian and New Zealand FSI rates against those of other countries. It is not clear at this stage how far it will be possible to take this analysis, given the large differences between traffic systems, vehicle fleets and data systems when comparing across national boundaries. At the very least, it is expected that comparison of the relative performance of different road types within overseas jurisdictions with the relative performance of different Australian and New Zealand road stereotypes will yield useful insights regarding potential areas for safety improvement.

Reference

Bradshaw, C., Turner, B., Makwasha, T. & Cairney, P. (in press), *Road Fatalities and Serious Injuries in Australia and New Zealand*, 2001-2010, forthcoming Research Report, Austroads, Sydney.