# BENCHMARKING TRUCK SAFETY IN AUSTRALIA

Narelle Haworth and Peter Vulcan, Research and Safety Services Pty Ltd and
Peter Sweatman, Road User Systems Pty Ltd, Melbourne

## ABSTRACT

This study was carried out to benchmark the safety performance of Australia's road transport industry against the safety performance of similar industries in a range of OECD countries. Its purpose was to guide the development of future policies to improve the safety of the Australian road transport industry, and to provide a focus for the national heavy vehicle safety strategy.

Comparisons were made of truck fatalities in Australia, the United States of America, Canada, New Zealand, the United Kingdom, France, Germany, and Sweden. Fatality rates were used because of the range of comparable data. Injury data were not used because injury reporting criteria and completeness of reporting vary within Australia and in other countries. The study found that Australia's heavy vehicle fatality rate per kilometre travelled is 47% higher than the USA, 39% higher than the UK, comparable to Germany & Canada, 20% lower than Sweden, 45% lower than France, and 55% lower than New Zealand.

The higher fatality rates on Australian roads compared to Great Britain and the United States may be largely explained by the lower proportion of truck travel on divided and limited access roads in Australia, and possibly truck speed limits. Areas that have the potential to improve the safety performance of the heavy vehicle industry include road standards, targeted low cost road safety treatments, single vehicle crashes, day and night time driving, measures to improve the safety of truck occupants, front and rear underrun protection, appropriate speed limits, and data collection.

## INTRODUCTION

Road transport carries a major proportion of Australia's land transport task but truck crashes often have very severe outcomes. This benchmarking study sought to compare truck safety in Australia with other countries with good safety records. Its purpose was to guide the development of future policies to improve the safety of the Australian road transport industry, and to provide a focus for the national heavy vehicle safety strategy.

Comparisons were limited to fatal crashes because it is known that injury reporting criteria and completeness of reporting vary within Australia and in other countries. The truck fatality rate has been declining in Australia and other countries during the past decade or so. Yet the Australian truck fatality rate is considerably higher than that in the United States and some other countries, but the reasons for this are not well understood.

## METHOD

In this study a truck was defined as a heavy commercial vehicle other than a bus with a gross vehicle mass rating of 4.5 tonnes or more (or 3.5 tonnes where it was not possible to exclude vehicles of 3.5 to 4.5 tonnes). Details of definitions and caveats on the data can be found in Haworth, Vulcan and Sweatman (2002).

The National Road Transport Commission requested data for this study from the relevant government agencies in Canada, France, Germany, New Zealand, Sweden, Great Britain and the United States. In order to enable crash rates to be calculated, the number of registered vehicles and the annual distance travelled for each category of truck was also requested. Unfortunately the amount of data received varied greatly from country to country and the definitions of some of the variables eg type of truck, gross vehicle mass were different. Data from Sweden was of limited value because trucks were only included in their data if their GVM exceeded 7 tonnes. Even after obtaining additional data from other sources such as reports, web sites and personal contacts, there are still gaps in the detailed data available for each of the eight countries. The latest year for which detailed data was available for fatal truck crashes in Australia was 1996.

## RESULTS

### Trends in numbers of fatal truck crashes

Table 1 shows that the trend in the number of fatal truck crashes is generally downward although it is less pronounced in the United States than in the other countries shown. In fact the number has risen in the United

States during recent years. For Australia, the total number of fatal crashes involving trucks is known for only a subset of years, so the number of articulated truck fatal crashes has been shown.

**Table 1 Trends in the number of fatal truck crashes**

| Year | Australia | | New Zealand | United States | Canada | France | Germany |
|---|---|---|---|---|---|---|---|
| | All trucks | Articulated trucks | | | | | |
| 1989 | | 250 | 107 | 4674 | 574 | | |
| 1990 | 342 | 205 | 85 | 4518 | 562 | | |
| 1991 | | 156 | 81 | 4097 | 502 | | |
| 1992 | 270 | 154 | 78 | 3825 | 453 | 1120 | 1696 |
| 1993 | | 171 | 87 | 4101 | 516 | 1106 | 1637 |
| 1994 | 265 | 151 | 96 | 4373 | 489 | 1065 | 1657 |
| 1995 | | 165 | 107 | 4194 | 465 | 1086 | 1678 |
| 1996 | 245 | 161 | 77 | 4413 | 435 | 946 | 1526 |
| 1997 | 257 | 146 | 86 | 4614 | 468 | 918 | 1529 |
| 1998 | 227 | 151 | 75 | 4492 | 423 | 947 | 1372 |
| 1999 | | 161 | 97 | | | 898 | |
| 2000 | | 165 | | | | | |

**Comparison of fatality rates for trucks and all vehicles**

The number of persons killed in truck crashes per $10^8$ kilometres of truck travel is lowest in the US (1.69) and Great Britain (1.79), while Germany (2.22), Canada (2.10) and Australia (2.49) have somewhat higher, but similar, rates. The rates for France (4.4) and New Zealand (5.52) are considerably higher. Thus, the Australian truck fatality rate is 47% higher than that for the United States, 39% higher than Great Britain, comparable to that for Germany and Canada, and about 45-55% below the rates for France and New Zealand.

The ratio of the truck fatality rate to the total road fatality rate is an indicator of the extent to which the truck fatality risk is greater than the overall road fatality risk. The ratio varies from low values of 1.49 in Great Britain, 1.72 in the United States and 1.79 in Germany, to 2.93 in France and 3.30 in New Zealand. The ratio of 2.07 for Australia is below the midpoint of the range, but it indicates that when compared with Great Britain, the United States and Germany, the Australian truck fatality risk is worse than the overall road fatality risk.
The truck fatality rate per registered vehicle shows a somewhat different relationship between countries to the extent that the distance travelled per truck varies between countries. Thus the much greater distances travelled by the average truck in Canada (54,751 km) and the United States (43,302 km) compared with Australia (30,046 km) result in the Canadian rate (11.48) being considerably greater than the Australian rate (7.47) and the United States rate (7.34) being approximately the same as the Australian rate.

**Comparisons of fatal crash characteristics**

Table 2 shows that about two-thirds of fatal truck crashes involved articulated trucks in Australia, Canada and the United States. The percentage of articulated trucks in crashes was much lower in New Zealand (18.6%) and Great Britain (38.2%), which may reflect the lower proportion of articulated trucks in these two countries. In this study a rigid truck towing a trailer such as the "truck and dog trailer" commonly used in New Zealand and Great Britain is defined as a rigid truck rather than as an articulated truck.

The percentage of crashes in urban areas in Australia (42%) is higher than that for New Zealand, Germany, Sweden and Canada (23.6% - 28.8%) and may reflect the higher urban speed limit in Australia.

The percentage of single vehicle crashes (including pedestrians) is higher for Australia (24.9%) than for other countries (14.0% to 19.8%). The percentage of single vehicle crashes that involved only the truck (not a pedestrian) was also higher in Australia (13.9%) than in the other jurisdictions (5.5% to 10.1%). The difference may be due to such factors as a lower traffic density which results in a lower probability of encountering other vehicles, a smaller percentage of travel on roads with safety features to reduce the probability of fatal single

vehicle crashes, eg sealed shoulders and fewer roadside hazards, or possibly greater driver impairment due to fatigue, alcohol or drugs. These factors warrant further investigation, if the relevant data can be obtained.

**Table 2 Summary table for all trucks – characteristics of crashes**

| Item | Nations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Aust** | **NZ** | **GB** | **France** | **Germany** | **Sweden** | **Can** | **USA** |
| Period | 1996 | 1997-9 | 1998 | 1998 | 1998 | 1998 | 1998 | 1998 |
| Fatal crashes | 245 | 86 | | 947 | 1372 | 106 | 423 | 4,492 |
| Articulated truck crashes (%) | 62.9 | 18.6 | 33.1 | | | | 63.6 | 69.6 (1) |
| All SV crashes (incl. peds) (%) | 24.9 | 19.8 | 10.2 | 14.0 | | 19.8 | 16.1 | 18.0 |
| Truck-only crashes (%) | 13.9 | 10.1 | 5.9 | 5.5 | 6.3 | 5.7 | | |
| Truck-ped crashes (%) | 11.0 | 9.7 | 4.3 | 8.6 | | 14.2 | | |
| Urban (%) | 42.1 | 27.5 | 63.9 | | 24.9 (2) | 23.6 | 28.8 | |
| Speed zone (%) | | | | | | | | |
| <60 km/h | 0.5 | 19.8 | 31.0 (3) | | | 16.0 | 18.3 | |
| 60 km/h | 25.0 | 2.3 | 9.6 (3) | | | | 5.1 | |
| 70-75 km/h | 5.5 | 5.4 | | | | 22.6 | 6.6 | |
| 80 km/h | 10.0 | 3.1 | 3.5 (3) | | | | 16.5 | |
| 90 km/h | 1.4 | 0.0 | | | | 50.9 | 29.7 | |
| 100 km/h | 39.5 | 69.4 | 29.0 (3) | | | | 23.4 | |
| >100 km/h | 18.2 | 0.0 | 26.8 (3) | | | 10.4 | 0.3 | |
| Night 1800-0559 (%) | 38.8 | 27.5 | 18.1 | 28.5 | | | 32.6 | 31.4 |
| Divided road (%) | 20.6 (2.0 free-ways) | Unknown (2.5 motor-way) | 34.4 | Unknown (12.1 auto routes) | Unknown (21.2 auto-bahns) | 2.8 | 20.8 (3.1 freeways) | 42.9 (25.6 Interstate Highway) |

Note: Where some data is unknown, the percentages are calculated as "percent of known".

(1) based on trucks involved in fatal crashes, which would be somewhat greater than the number of crashes

(2) "inside towns" and "outside towns" both exclude autobahns

(3) GB speed limits are in mph. These have been grouped as following: (<30 mph, 30 mph into <60 km/h), (40 mph into 60 km/h), (50 mph into 80 km/h), (60 mph into 100 km/h), (70 mph and >70 mph into >100 km/h)

The much higher percentage of truck fatal crashes on limited access roads in the United States (25.6%) compared with 2.0% for Australia and 2.5% for New Zealand, is a partial explanation for the lower fatality rates achieved in the United States and Great Britain. The same applies for the much higher percentage of truck crashes on divided roads (including freeways) in the United States (42.9%) compared with Australia (20.6%).

These findings are likely to reflect the much greater prevalence of limited access roads in the United States than in Australia. Austroads (2000) defines "controlled access roads" as roads that are grade separated, having dual carriageways and having a length greater than 5 km. There were 1563 kms of controlled access roads in Australia in June 1999. This compares to 18,400 kms of National highway, 96,840 kms of rural arterial roads and 12,232 kms of urban arterial roads. In urban areas of Australia, there is 6.6 km of controlled access road per billion vehicle-km. In urban areas of the United States, there is 8.3 km of controlled access road per billion vehicle-km.

The percentage of fatal truck crashes which occur at night varies from 28.5% for France to 37.4% for Australia. This higher proportion of fatal crashes at night in Australia may be due to the greater exposure, or poorer conditions for night-time travel and warrants further investigation.

Table 2 also shows that in Australia 57.7% of truck crashes occur in speed zones of 100 km/h or greater, while in New Zealand the figure is 69.4%, but in Canada is only 23.7%. When the 90 km/h speed zones are included the Canadian figure is 53.4% and the Australian figure 59.1%. It should be noted that in New Zealand, Great Britain, several States of the United States and in some other countries the maximum speed limit of trucks is lower than that for cars.

As shown in Table 3, the percentage of persons killed who are occupants of the trucks varies from 9.8% (France) and 10.4% (GB) to 19.0% in Australia. The somewhat higher percentage in Australia is consistent with Australia having the largest percentage of truck-only truck fatal crashes. It also indicates the need for further analyses to determine whether occupant protection in Australian trucks is poorer than in those of other countries, or whether other factors are involved.

The percentage of persons killed who were non-occupants (pedestrians and bicyclists) in Australia was mid-way between the low percentages reported in France, Canada and the United States and the higher percentages reported in Great Britain. This probably reflects the greater number of unprotected road users exposed to crashes in Great Britain.

**Table 3 Summary table for all trucks – characteristics of persons killed**

| Item | Nations | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Aust** | **NZ** | **GB** | **France** | **Germany** | **Can** | **USA** |
| Period | 1996 | 1997-9 | 1998 | 1998 | 1998 | 1998 | 1998 |
| Fatalities | 294 | 102 | 576 | 1102 | 1515 | 505 | 5,316 |
| Fatalities per $10^8$ kms | 2.49 | 5.52 | 1.9 | 4.4 | 2.22 | 2.10 | 1.69 |
| Fatalities per 10,000 registered trucks | 7.47 | 14.03 | 13.7 (1) | | 4.83 | 11.48 | 7.34 |
| Persons killed (%) | | | | | | | |
| Truck occupants | 19.0 | 12.8 | 10.4 | 9.8 | 16.1 | 13.1 | 13.9 |
| All other vehicle occupants (incl. motorcyclists) | 65.3 | 72.4 | 68.9 | 78.6 | | 76.0 | 76.8 |
| Non-occupants | 15.7 | 14.7 | 20.7 | 11.6 | | 10.9 | 9.3 |

(1) may be inflated by crash data including non-GB trucks but registration data being GB-registered only

The sections that follow present crash and fatality data disaggregated into articulated and rigid trucks. Data for articulated and rigid were not available for France, Germany and Sweden. Very limited data was available for the United States and was expressed in terms of trucks involved, rather than in terms of number of crashes.

**Articulated truck crashes**

Table 4 shows that for articulated trucks the fatal crash rate per $10^8$ km travelled is much higher for Australia (3.02) than for Canada (1.52) and for Great Britain. This is in contrast to these rates being similar for all trucks and shows a much greater risk for articulated trucks in Australia. The rate per $10^4$ registered vehicles in Australia (26.6) is also higher than the Canadian rate (18.2), but the difference is not as large, because the average Canadian articulated truck travels a greater distance annually.

Australia has a similar number of fatalities per articulated truck crash as Canada (1.22 versus 1.19) but the number for New Zealand (1.38) is somewhat larger.

For articulated trucks, the percentage of single vehicle crashes in Australia (25.3%) and New Zealand (25.0%) is much higher than in Canada (14.5%) and Great Britain (10.3%). In Australia 71.2% of articulated truck fatal crashes occur in speed zones of 100 km/h or greater, while in New Zealand the figure is 85.4% and in Canada only 29.4%. (Even when the 90 km/h speed zones are included the Canadian figure is only 60.7%.) If travel speeds are related to the legal speed limit, this could be a partial explanation of the reasons why the Australian fatal crash rate is 99% higher than the Canadian rate.

**Table 4 Fatal crashes of articulated trucks – overall**

| Item | Nations | | | | |
|---|---|---|---|---|---|
| | Aust | NZ | GB | Can | USA |
| Period | 1996 | 1997-9 | 1998 | 1998 | 1998 |
| Fatalities | 188 | 22 | | 319 | |
| Fatal crashes | 154 | 16 | 227 (1) | 269 | 3,435 (1) |
| Fatalities/fatal crash | 1.22 | 1.38 | | 1.19 | |
| Fatal crashes/$10^8$ artic km | 3.02 | 4.97 | 1.83 (1) | 1.52 | |
| Fatal crashes /10,000 registered artics | 26.6 | 22.69 | 20.5 (1) | 18.2 | |

(1) based on trucks involved in fatal crashes, which would be somewhat greater than the number of crashes

The percentage of articulated truck fatal crashes on divided roads in Australia (17.4%) is lower than in Canada (25.3%) and Great Britain (25.1% on motorways plus an unknown percentage on other divided roads).

The percentage of articulated truck fatal crashes at night in Australia (44.8%) is higher than in Canada (34.8%) in New Zealand (31.3%) and in Great Britain (24.9%). This could be a contributor to the higher rate in Australia.

In Australia 21.8% of the fatalities are occupants of the articulated truck compared with 11.9% in Canada and 15.2% in New Zealand. As discussed for all truck crashes, this is consistent with Australia having a high percentage of truck-only crashes among fatal articulated truck crashes.

**Rigid trucks**

Table 5 shows that for rigid trucks, the number of fatal crashes per $10^8$ km travelled is considerably lower in Australia (1.41) than in Canada (2.56) and New Zealand (4.59). Similarly, the number of fatal crashes per 10,000 registered vehicles is considerably less in Australia (2.83) than in Canada (5.58) and New Zealand (11.76). These results contrast with the higher fatality rates in Australia than in Canada for articulated trucks.

**Table 5 Fatal crashes of rigid trucks – overall**

| Item | Nations | | | | |
|---|---|---|---|---|---|
| | Aust | NZ | GB | Can | USA |
| Period | 1996 | 1997-99 | 1998 | 1998 | 1998 |
| Fatalities | 110 | 80 | 408 | 187 | |
| Fatal crashes | 95 | 70 | 368 (1) | 163 | 1,195(1) |
| Fatalities/crash | 1.16 | 1.14 | 1.11 (1) | 1.15 | |
| Fatal crashes/$10^8$ rigid km | 1.41 | 4.59 | 1.87 | 2.56 | |
| Fatal crashes/ 10,000 registered rigids | 2.83 | 10.67 | 11.9 (2) | 5.58 | |

(1) based on trucks involved in fatal crashes, which would be somewhat greater than the number of crashes

(2) may be inflated by crash data including non-GB trucks but registration data being GB-registered only

In Australia 23.2% of rigid truck fatal crashes are single vehicle compared with 17.8% in Canada, 18.6% in New Zealand and 10.2% in Great Britain. This difference is consistent with the data for all trucks. About half of the rigid truck crashes in Australia occurred in urban areas. In contrast, only about 30% of rigid truck crashes in New Zealand and Canada occurred in urban areas. This may reflect greater use of rigid trucks in urban areas (compared to rural areas) in Australia, than in New Zealand and Canada.

In Australia 37.8% of rigid truck fatal crashes occur in 100 km/h or greater speed zones, whereas in Canada the corresponding figure is 16.5% (if the 90 km/h speed zones are included the Australian figure rises to 41.9% and the Canadian to 42.5%). In Australia 30.4% of rigid truck crashes occur at night compared with 18.7% in Canada and 26.7% in New Zealand. This difference is not as great as for articulated truck crashes. The 28.9% of rigid truck fatal crashes which occur on divided roads in Australia is greater than the 14.2% in Canada. These differences may reflect the greater use of truck and dog trailers in preference to articulated trucks in Great Britain and New Zealand.

The number of fatalities per rigid truck fatal crash is similar for Australia, Canada and New Zealand. The proportion of persons killed who were occupants of the rigid trucks is somewhat higher in Australia (17.3%) than in Canada (15.0%) and in New Zealand (12.1). This is consistent with the figures for all trucks.

## DISCUSSION

Various factors can influence the total number of fatal crashes, including total distance travelled, changes to vehicle safety standards, improvements to the road system and regulations relating to truck operations. As most fatalities in fatal truck crashes are not truck occupants, these factors are relevant not only for truck operations, but also for all road users.

Based on simple assumptions, it can be shown that if Australian roads were upgraded to having similar proportions of divided and limited access roads, as in the United States or Great Britain, the Australian truck fatality rate could be expected to be similar to that in these countries and well below the rates in Canada and Germany. Upgrading of the Australian road system to these standards could take several decades and require significant investment. There are, however, lower cost road and roadside treatments which could achieve some of the potential benefits more rapidly and at a fraction of the cost. In the meantime there is also potential to achieve reductions in the truck fatal crash rate through measures directed at road user behaviour and the vehicle.

Higher speed limits in Australia than in Europe and parts of the United States, particularly for articulated trucks on roads of less than freeway standard may also be a contributory factor to the higher Australian truck fatal crash rate, although actual speeds depend on the extent of speed enforcement and use of speed limiters.
Compared with the other countries, Australia has the highest proportion of single vehicle fatal crashes and the highest proportion of truck occupant fatalities. There is potential to reduce truck occupant fatalities through less night-time driving, improved fatigue control, more protective cabin structures and increased use of seat belts by truck occupants.

In regard to multi-vehicle crashes there is also potential to reduce car occupant fatalities by providing improved truck rear and front underrun barriers. In addition, side underrun barriers or skirts have the potential to reduce fatalities of unprotected road users.

The data which is available for Australia and the other countries limited the comparisons which could be made, particularly for articulated and rigid trucks separately. There is a need to collect more data on both truck crashes and exposure to enable further progress to be made in research relating to truck safety in Australia.

## ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance of the organisations which provided information for each country as well as the following people, who provided additional information.

- NRTC staff, particularly Peter Makeham and Fiona Calvert.
- Michelle Walker of Australian Transport Safety Bureau.
- M. F. Perret and M. Annie Canel of Service d'Études Techniques des Routes et Autoroutes, France.
- Heather Ward of the Centre for Transport Studies, University College, London.
- Wayne Jones of Land Transport Safety Authority, New Zealand.
- Klaus Langwieder, Institut fur Fahrzeugsicherheit, GDV, Germany.
- Ken Campbell, University of Michigan, Transportation Research Institute.
- Bob Clarke, Office of the Secretary, US Department of Transportation.

## REFERENCES

Haworth, N., Vulcan, P. and Sweatman, P. (2002). Truck safety benchmarking study. Report prepared for National Road Transport Commission.