The cost of road crashes in Australia 2016:

An overview of safety strategies

A report drafted for Senator Alex Gallacher

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Executive Summary

This report builds on research by the Bureau of Infrastructure, Transport and Regional Economics (BITRE) in 2009 to calculate the total social cost of road crashes. The report updates the costs for 2016 using new fatality and injury data, and includes estimates of the cost of property damage. The results can serve as a useful guide for policy makers when assessing the merits of safety strategies in Australia.

Trends in fatality data are explained, including comparisons between heavy trucks and non-heavy vehicles as well as state-based and time-based comparisons. State and territory injury data are analysed to estimate the number of serious and minor injuries from road crashes in 2016. The property damage costs arising from road crashes are also calculated.

There were 1295 fatalities from road crashes in Australian for 2016. The report's analysis shows that this is a 19% decrease from 10 years ago in 2006, but is a 13% increase on the lowest fatality year of 2014. Since 2006, Australia has fallen from 14 out of 34 to 17 out of 34 in OECD rankings for fatalities per capita. Fatalities per 1 billion vehicle kilometres travelled were 5.19 in 2016 and fatalities per 100,000 people were 5.4. Heavy trucks were involved in 14.7% of fatalities in 2016, despite making up 3.13% of registered vehicles and 7.2% of vehicle kilometres travelled.

There is currently no nationally consistent road crash injury data in Australia due to state/territory methodological differences. The report's estimations are that there were 32,300 serious injuries and 224,104 minor injuries sustained from road crashes in 2016.

This report used a willingness to pay method of estimating the cost of road crashes, with the outcome being an average cost per fatality of $7.8 million, cost per serious injury of $310,094 and cost per minor injury of $3,057. It was found that property damage costs increased relative to 2006 by 36.5% including inflation, as a result of higher insurance administration costs and vehicle repair costs, of which 22% are borne by heavy trucks.

On this basis, the total social cost of road crashes in Australia for 2016 was $33.16 billion. $9.38 billion in property damage costs, $10.2 billion in fatality costs and $13.58 billion in injury costs. This is a total increase from 2006 of 22%, which is less than overall CPI, but still equates to 2% of GDP.

The report also provides a comprehensive overview of the different types of safety strategies and their management in Australia, presenting what is being done and what could be done under five categories of: management/resources, leadership/awareness, roads/infrastructure, technology and heavy trucks, concluding with some recommendations in these areas.

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Abbreviations

AAA	Australian Automobile Association
ABS	Australian Bureau of Statistics
ACRS	Australasian College of Road Safety
AEB	Autonomous emergency braking
AIHW	Australian Institute of Health and Welfare
ANCAP	Australasian New Car Assessment Program
AusRAP	Australian Road Assessment Program
BITRE	Bureau of Infrastructure, Transport and Regional Economics
ESC	Electronic stability control
FWS	Fatigue warning systems
GDP	Gross domestic product
HCA	Human capital approach
HVNR	Heavy Vehicle National Regulator
ITF	International Transport Forum
LDWS	Lane departure warning systems
NHVR	National Heavy Vehicle Regulator
NRSS	National Road Safety Strategy
NTC	National Transport Commission
OECD	Organisation for Economic Cooperation and Development
RSRT	Road Safety Remuneration Tribunal
VKT	Vehicle kilometres travelled
VLY	Value of a statistical year
VSL	Value of a statistical life
WTP	Willingness to pay

1. Introduction

Background

Every day in the media there are reports of road crashes on Australian roads. In the more severe crashes human beings sustain injuries and in the worst cases, lose their lives. Losing a life is the ultimate cost of an action or accident, but with well over 1000 fatalities occurring from road crashes every year, the public is somewhat numbed to this result. This is why it is important to determine the total social cost of road crashes in order to reinforce the seriousness of road crashes to the community. While the number is of little comfort to the families of loved ones who have been impacted by road crash casualties, it is crucial for policy makers attempting to reduce the road toll.

The Australian Federal and State Governments have finite budgets and Australians lose their lives due to many different causes that can legitimately compete for these funds. Cancer, heart disease and suicide are all examples of areas of significance for policy makers when allocating resources to save lives. Every safety strategy, such as upgrading the road network and mandating child booster seats, has an opportunity cost. If the total cost of a safety strategy is greater than the value of the crashes it will prevent, then these resources should be allocated to other projects instead (Gruber 2010).

Fatality data is easy to collect and is a statistic that is not only powerful, but is easy to compare over time and across countries. In Australia, fatalities from road crashes peaked in the 1970s at over 3,000 a year and in 1996 had decreased to under 2,000 (BITRE 2009). A greater awareness around safety and the introduction of new technologies have reduced the road toll over time despite an increasing population and an increasing number of vehicles. In 2006 there were 1598 fatalities and by 2014 this number had decreased to a record minimum of 1,150, but over the last two years fatalities have risen and now stand at an alarming 1,295. Since 2006, Australia has fallen from 14/34 to 17/34 in OECD rankings for fatalities per capita (OECD 2017).

Due to the number of fatalities being a sensitive statistic and the easiest to analyse, safety technologies have tended to focus on saving lives. This is a good thing for the community, but the number of serious injuries in Australia has been steadily increasing over the last 15 years, with an average around 620 per week in 2016. Injury costs make up 40% of the total social cost of road crashes, chiefly due to disability related costs, medical costs and out of work productivity costs (BITRE 2009).

Objective

In 2009 the Bureau of Infrastructure, Transport and Regional Economics (BITRE) produced a thorough and detailed report on the total social cost of road crashes in Australia for 2006, consistent with its previous report for 1996. The report found the total cost of crashes to be $27.12 billion (2006 dollars) and included a wide ranging analysis of different cost components, which are examined in section 4.

This report relies heavily on the BITRE research but attempts to update the costs for 2016 using new fatality, injury and property damage data. The results should serve as a useful guide for policy makers when assessing the merits of safety strategies in Australia.

This report also seeks to provide a comprehensive overview of the different types of safety strategies and their management in Australia, identifying what is being done and what could be done.

There are many significant areas of interest that could contribute to a case study into the effects and causes of road crashes, such as drink-driving, motorcycle accidents and the safety of older drivers. However, this report will focus on heavy vehicles, specifically the trucking industry. It seeks to identify the impact that crashes with heavy truck involvement have on fatalities, injuries and the economy, while also assessing what safety improvements are being made in the industry.

Organisations

In the international sphere, many countries have produced their own reports for the cost of road crashes. For example, the New Zealand Ministry of Transport produces a report every two years on the cost of crashes on New Zealand roads, and the United States Department of Transportation produced an extensive report for 2010. The International Transport Forum (ITF) compares crash statistics between countries and has less recent data on crash costs.

In terms of road safety, there are numerous effective organisations in Australia making a difference either at the research stage, awareness stage or implementation stage. The Australasian College of Road Safety (ACRS) is the prominent interest group lobbying the Federal Government to focus more on road safety. Institutions such as Austroads, the Australian Automobile Association (AAA) and the Australasian New Car Assessment Program (ANCAP) produce valuable investigations into the safety of road infrastructure and new vehicle safety technologies. At the Federal Government level, the National Road Safety Strategy (NRSS) outlines safety measures, with a target of reducing fatalities and serious injuries by 30% from 2011-2020. BITRE produces numerous detailed reports on road crash statistics and evaluations of safety strategies.

Structure of Report

Section 1 presents an overview of the significance of road crashes, the organisations that are involved in Australia and highlights the objectives of the report. Section 2 presents data on fatalities in Australia for 2016 and compares results over time and for heavy trucks. Section 3 outlines the limitations around injury data in Australia, while also estimating and comparing results for 2016. Section 4 details the methodology for costing road crashes, including the nuances around the economic value of a life. It then evaluates the results with comparisons to 2006 and analysis for heavy trucks. Section 5 shifts the focus to safety strategies in terms of institutions, infrastructure and new technologies. Section 6 details truck specific safety strategies in Australia. Section 7 of the report looks at possible future issues in road safety, and Section 8 lists several recommendations arising from the project.

2. Fatalities

Methodology

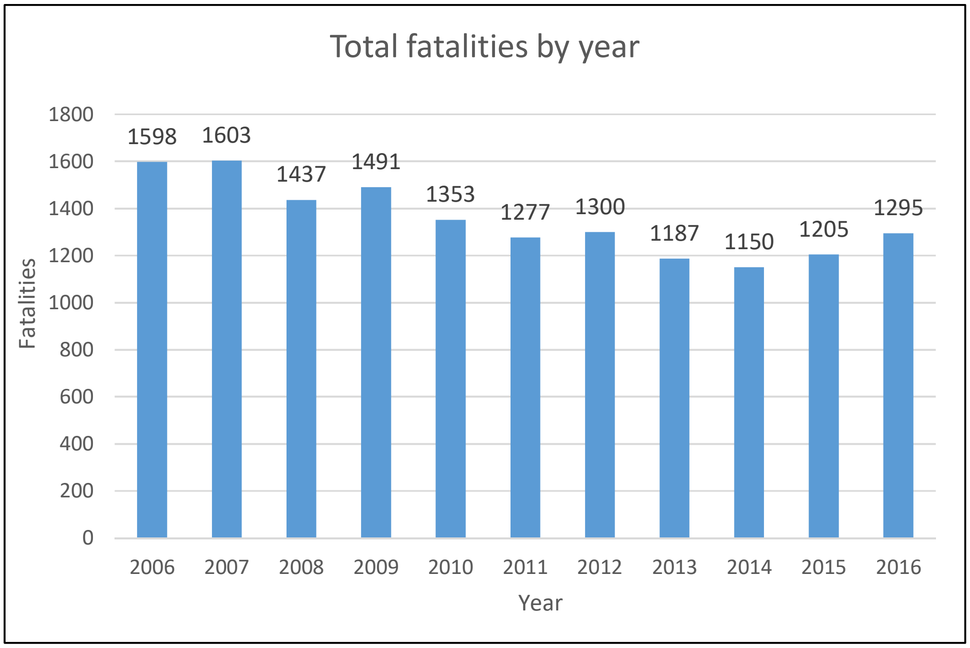
All definitions used in this section are consistent with the BITRE 2009 report. A road crash fatality is a person who died from a crash within 30 days due to their injuries. This therefore excludes indirect victims such as suicides. A fatal crash is different from a fatality, in that a fatal crash involves all vehicles in the one initial accident and can therefore have more than one fatality. A vehicle that runs off road and crashes by itself is still considered a fatal crash, as is a one person fatal bicycle accident. To be classified as a road crash the crash has to occur on a public road and involve a road vehicle. This therefore excludes crashes occurring in carparks and on private property, as well as crashes involving only non-road vehicles, such as go-karts (BITRE 2009).

Data for 2016 can be extracted from "Australian Road Deaths Database: Fatalities" (BITRE 2017b) and "Australian Road Deaths Database: Fatal Crashes" (BITRE 2017a). For this report, 2016 data is current as at April 2017. While preliminary data for 2017 is available, it will not be considered at all in this report.

Results

There were 1295 fatalities from road crashes in Australian for 2016. Figure 2.1 shows this is a 19% decrease from 10 years ago in 2006, but is a 13% increase on the lowest fatality year of 2014.

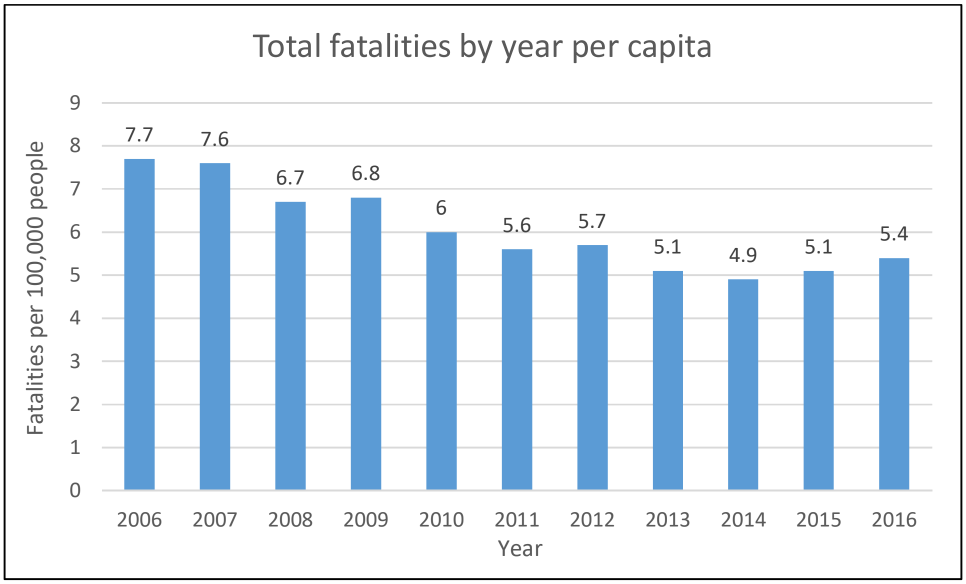
Figure 2.1 Total fatalities by year



Source: BITRE (2017b)

Considering that the Australian population has grown by 17% in the last 10 years, to more accurately assess the breakdown of fatalities over time it is necessary to look at fatalities per head of population. Figure 2.2 shows that there are currently 5.4 road fatalities per 100,000 people in Australia. Comparing Figures 2.1 and 2.2 indicates that the total decrease in fatalities from 2006 when accounting for population is around 30% (compared to 19%), while the increase from 2014 is only 10% (compared to 13%). Internationally however, Australia has slipped from 14/34 to 17/34 in OECD rankings for fatalities per 100,000 people, well behind the UK at 2.77 and global leaders in Scandinavia, such as Sweden at 2.64 and Norway at 2.25 (OECD 2017).

Figure 2.2 Total fatalities by year per capita

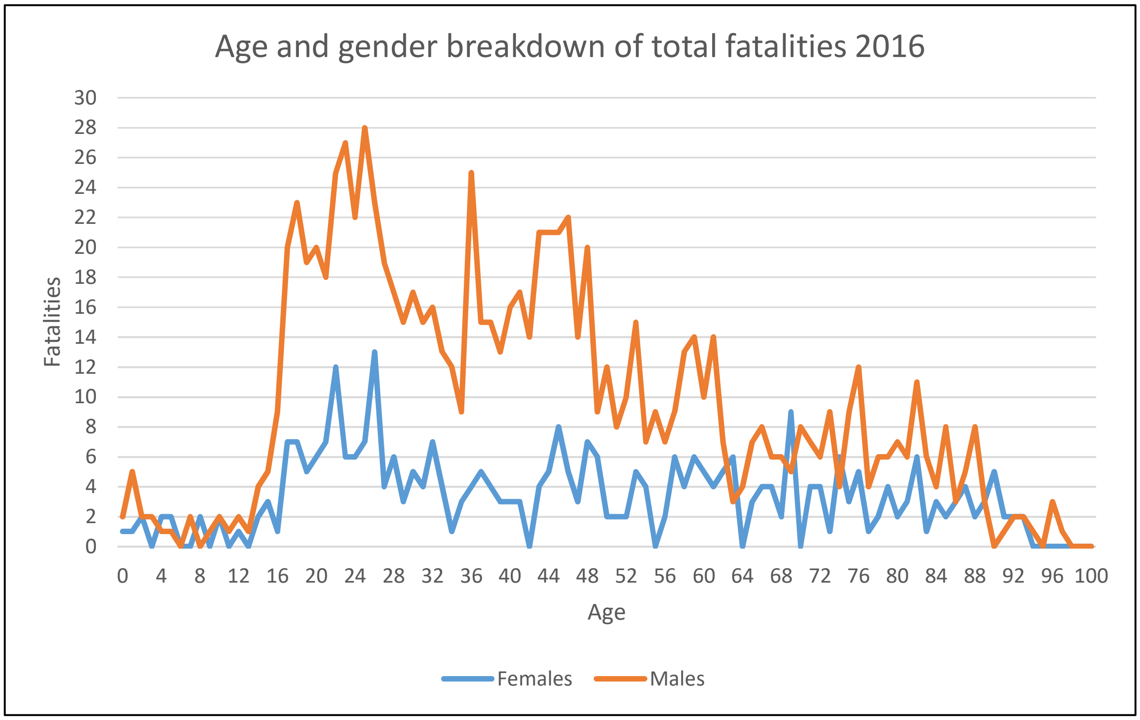


Source: BITRE (2017b)

The number of fatalities per 100,000 registered vehicles were 7.12 in 2016, which is a 36% decrease on 2006. Fatalities per 1 billion vehicle kilometres travelled (VKT) were 5.19 in 2016, which is a 32% decrease on 2006. These results show that although there are more people driving, more vehicles on the road and more driving being done in Australia, fatalities have still decreased significantly from 2006.

Fatalities for 2016 can be broken down by age and gender which is shown by Figure 2.3. The average age for a road fatality was 44 years. This has stayed relatively constant in the last five years and can be compared with the average Australian age of 37, the difference in the two statistics being explained in the graph by the high number of fatalities for 80-96 year olds compared to 0-16 year olds. The data also shows a spike in fatalities for men in their 20s, and overall men are much more likely to die on roads than women, accounting for 73.9% of fatalities.

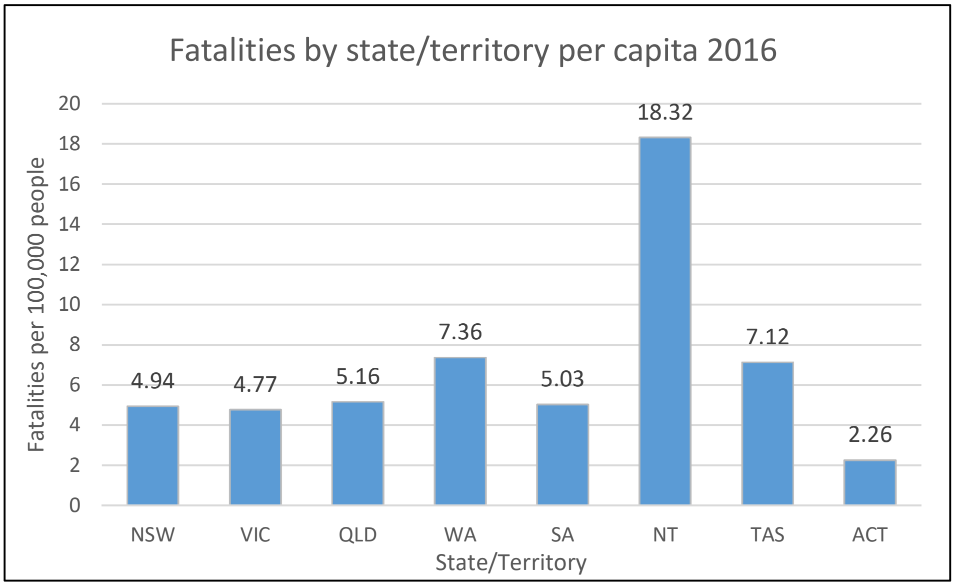
Figure 2.3 Age and gender breakdown of total fatalities 2016



Source: BITRE (2017b)

Looking at where fatalities occurred in terms of state and territory boundaries shows that the distribution stays reasonably consistent with population, in that New South Wales, Victoria and Queensland have the most. However, taking fatalities per 100,000 people by state/territory as shown by Figure 2.4, indicates that the Northern Territory is the jurisdiction with by far the worst statistics, with Western Australia a distant second. This could be a reflection on the low population density in those states meaning a greater percentage of high speed roads, but is likely also to reflect socio-economic factors.

Figure 2.4 Fatalities by state/territory per capita 2016



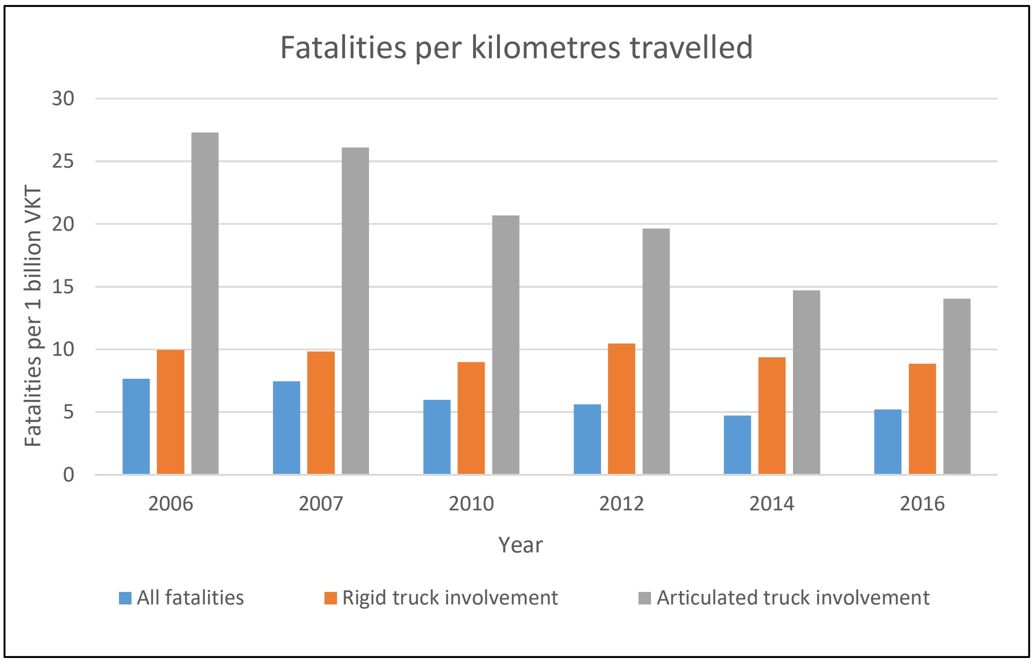
Sources: ABS (2017a), BITRE (2017b)

Heavy truck involvement

When analysing truck involvement in fatalities, it is clear that they are involved in a disproportionally high amount of crashes. It is important to note the distinction between being involved in a crash and causing a crash, while if there are two rigid trucks involved in a fatal crash, this is not double counted and is recorded as 1 unit of involvement. For explanations of the two truck classes (rigid and articulated), see Section 6.

Rigid trucks were involved in 7% of crashes in 2016 and articulated trucks were involved in 8.3%. In some cases there was both rigid and articulated truck involvement in a crash, therefore total heavy truck involvement equals 14.7% (not 7% + 8.3%). When compared to 2006, rigid truck involvement has increased, while articulated truck involvement has decreased. Figure 2.5 shows that in terms of the changing amount of VKT over time, rigid truck involvement in fatalities has stayed reasonably constant, while articulated truck involvement has steadily decreased by about 5% every year since 2006. This reflects the adoption of safety technologies and driving practices as articulated trucks become more common in the industry, with a 10% increase in the number of registered articulated trucks in Australia since 2006 (ABS 2013, ABS 2017c). Currently in Australia, rigid trucks make up 2.6% of total registered vehicles and articulated trucks 0.53%, while combined they contribute 7.2% of total VKT, yet are involved in 14.7% of fatalities. This highlights the importance of improving safety measures in the trucking industry for Australia's road toll.

Figure 2.5 Fatalities per kilometres travelled



Sources: ABS (2013), ABS (2015), ABS (2017c), BITRE (2017b)

For fatalities per crash type—single vehicle, multiple vehicle or pedestrian—, crashes with heavy truck involvement are classified as multiple vehicle over 80% of the time. This shows the devastating impact that these large vehicles have on other road users in a crash, further highlighted by the fact that for fatal crashes with heavy truck involvement there are on average 1.14 fatalities, but for regular fatal crashes only 1.08. Interestingly, crashes with heavy truck involvement are classified as single vehicle only 10% of time, compared to 45% for non-truck involvement crashes. This shows that truck drivers are far less likely to crash by themselves than regular drivers or riders.

In terms of trucks causing accidents, BITRE (2016b) found that for fatal multiple vehicle accidents with truck involvement, fault is attributed to the truck driver only 20% of the time. While this is a promising statistic, the trucking industry still has a significant responsibility in road safety due to the damage heavy vehicles can have when light vehicle drivers make mistakes.

3. Injuries

Methodology

A non-fatal injury resulting from a road crash is either serious or minor. The definition of a serious injury consistent with the 2009 BITRE report is any person who has been admitted to hospital. Unlike fatalities, there are significant methodological issues in analysing road crash injuries in Australia. Firstly, not all non-fatal road crashes are reported to police, especially motorcycle and bicycle single vehicle crash injuries. Secondly, not all seriously injured casualties go to hospital; some see private doctors, are treated at the scene by paramedics or see no-one. Thirdly, there is currently no nationally consistent database of serious injuries due to jurisdictional differences in coding the seriousness of specific injuries and disabilities. Finally, a data linkage approach which combines police records with hospital data on a national scale was recommended by (D'Elia & Newstead 2011) as well as (BITRE 2016a), but is still under development.

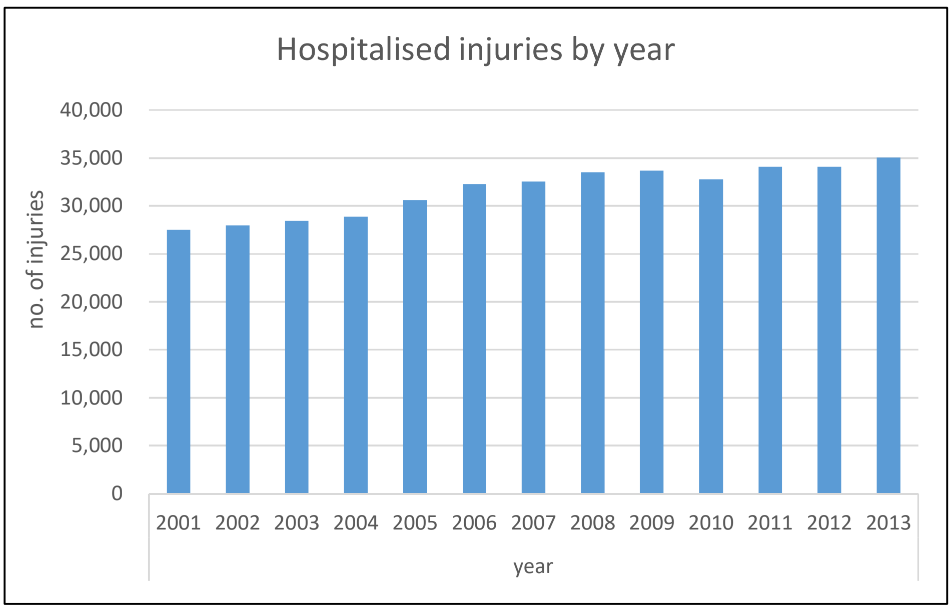
For this report, the number of serious injuries from road crashes in Australia for 2016 was estimated using a combination of state government casualty data and "Hospitalised Injuries" (BITRE 2017c), which is data from the Australian Institute of Health and Welfare (AIHW) to 2013 that was used in the 2009 BITRE report. The AIHW data for pre-2014 can be measured against the state and territory data for pre-2014 and the difference used to extrapolate the "Hospitalised Injuries: data for 2016 based on the sum of individual state and territory data for 2016. Where state data for 2016 is not yet available, 2015 data is used instead.

The number of minor injuries for 2016 is taken to be in the same proportion to serious injuries for 2006.

Results

Figure 3.1 shows hospitalised injuries taken from the AIHW data to 2013. There was an 8.6% increase in the number of hospitalised injuries from 2006 to 2013. Already this is a significant contrast to fatality data which is trending downwards over time.

Figure 3.1 Hospitalised injuries by year



Source: BITRE (2017c)

In terms of state government data, using their own classification system New South Wales had serious injuries peaking in 2014 before decreasing by 4% to the 2016 level (NSW 2017). For Victoria it is a similar story, their records have injuries decreasing by 6.6% since 2014 (VicRoads 2016). The results in Queensland are even more significant, with a 12% decrease from 2013 to 2015 which is the last year available (QLD 2017). The results for the other states and territories are slightly less conclusive, but for the three states with over 75% of Australia's population there is a clear decrease in serious injuries since 2013. This is in contrast to BITRE (2014; 2016a; 2016c) which all estimated road crash injuries in Australia to be increasing since 2013 to as high as 37,000 for 2016.

The number of serious injuries calculated for 2016 are outlined in Figure 3.2. The high number for the Australian Capital Territory is partly due to jurisdictional recording issues between the ACT and NSW.

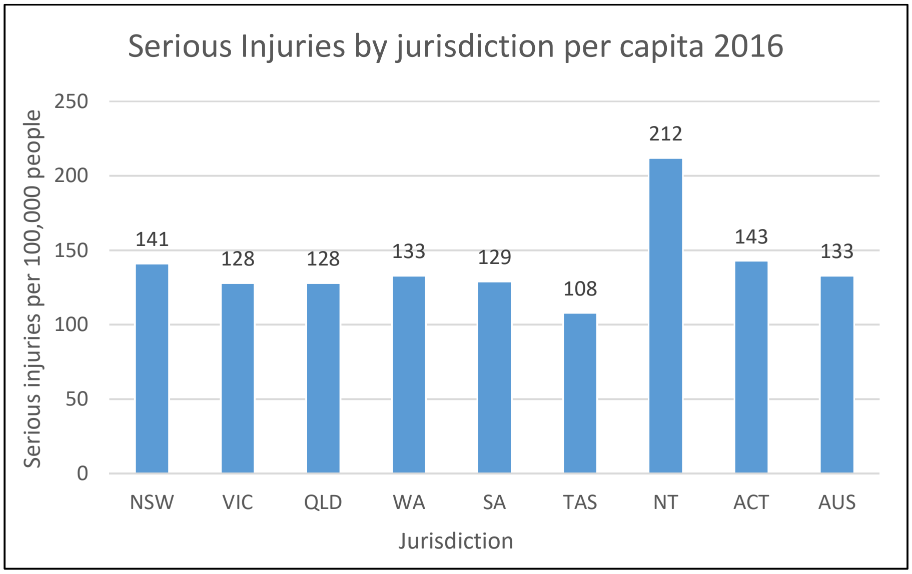
Figure 3.2 Serious injuries by jurisdiction 2016

	NSW	VIC	QLD	WA	SA	TAS	NT	ACT	AUS
Estimated serious injuries 2016	10950	7800	6200	3500	2200	560	520	570	32300

Sources: ACT (2016), BITRE (2017c), NSW (2017), NT (2016), QLD (2017), SA (2017), TAS (2017), VicRoads (2016), WA (2017)

The 32,300 serious injuries for Australia in 2016 is a very important number because it is the value used in Section 4 to estimate the total social cost of injury crashes. Figure 3.3 indicates serious injuries by region in 2016, adjusted for population. Similar to fatalities, the Northern Territory is the worst performing state or territory, but the margin is much narrower to second place, which is occupied by the ACT. The groupings of the other state and territories are very similar to the distribution for fatalities in Figure 2.4, with the exception of Tasmania.

Figure 3.3 Serious Injuries by jurisdiction per capita 2016



Sources: ABS (2017a), ACT (2016), BITRE (2017c), NSW (2017), NT (2016), QLD (2017), SA (2017), TAS (2017), VicRoads (2016), WA (2017)

Heavy truck involvement

Information on the role of trucks in road injury crashes is not widespread in Australia. BITRE (2016b) found that either rigid or articulated trucks are involved in 4% of road crash injuries. This is much lower than fatality results for 2016, which highlighted involvement levels of 15%. This backs up the claim in the literature that heavy vehicle involvement translates into more severe injuries. The same study (BITRE 2016b) found that for truck drivers there has been a small increase in the number of injuries sustained in the last ten years, in contrast to truck driver fatalities which have decreased by 7% on average every year. Overall this highlights that despite high fatality involvement levels, the trucking industry is not sitting idle in the road safety effort.

4. Costs

Value of a life

A cost-benefit analysis of a road safety strategy will express the costs of implementation in monetary terms, for instance the labour and capital costs of installing a set of traffic lights. The benefits of such a strategy are lives saved and injuries prevented, but what is the monetary value of this? Humans do not act as if their lives are priceless, due to the infinite number of risks taken every day just by walking down the street. The value of a statistical life (VSL) captures the lost potential of an individual to society in economic and social terms. This creates a common unit of measurement for cost-benefit analysis, allows for aggregation of fatality costs and creates the ability to compare safety strategies across different portfolios (Gruber 2010).

There are two main approaches to calculating the VSL. Firstly, the human capital approach (HCA) which captures the value in terms of lost economic productivity from not being able to work, earn income or participate in the household. This is calculated using basic economic indicators such as average weekly earnings and life expectancy. The HCA typically underestimates the VSL because it cannot properly account for children and especially elderly people, who have reduced future earning capacities, but still value their lives (Abelson 2008). The BITRE 2009 report uses a hybrid HCA that attempts to account for a wide array of costs including non-pecuniary family suffering.

The second approach to calculating the VSL is a willingness to pay (WTP) investigative method. Almost all recent studies in Australia and overseas have identified WTP as the better alternative because it allows for the individual's preferences to be expressed not guessed, and the NRSS has approved it as being the superior methodology for use in Australia. There are two main techniques to deduce and understand individuals' preferences for the value of their lives. The first is conducting surveys and asking people questions about certain safety strategies, for instance how much extra they would pay for electronic steering control in a new vehicle. This technique has the problem of survey framing effects and suffers from the well-known trait in behavioural economics of what people saying they will do being different to what they actually do (Abelson 2008). A full scale WTP survey for Australia would take over three years to complete, but cost only one million dollars (Austroads 2015).

The second technique is revealed preference studies, which attempt to determine individual preferences by looking at the choices people make in real life. For instance, how many people are buying this new car exactly the same as the old one except that it has new lane departure warning system technology? Or which route will a pedestrian take when given different options on travel time, injury risk, traffic volume and crossing safety? VSL is said to work well in this framework for people up to about 50 years of age, otherwise a more accurate measure such as the statistical value of a life year (VLY) should be used in order to reflect the changing nature of life expectancy as people get older. The average age an Australian male will live to when they are 44 (the average age of a road fatality in 2016) is 82, compared to 81 at birth, while for females the average age they will live to at 44 is 86 compared to 85 at birth (ABS 2016), so there would be negligible difference in using VLY instead of VSL in this report.

Methodology

This report relies heavily on the methodology in the BITRE (2009) report for 2006. That report was based on extensive research and data collection over a number of years. Using the HCA it found the total social cost of crashes for 2006 to be $17.85 billion dollars, broken down on the basis of 21.5% resulting from human related costs of fatalities, 40% resulting from serious and minor injuries and 38.5% resulting from property damage. 82.2% of the property damage costs were the result of repair costs (61.5%) and insurance administration costs (20.7%). For a full list of cost components, see Appendix A. For this report, the property damage costs after adjusting for inflation will be taken as constant except for these two components, which can be updated based on 2016 data.

The total fatality cost component in the 2006 study was $3.84 billion dollars, of which 78% is the result of human output losses measured by the HCA. For a full list of cost components, see Appendix A. Per individual road death the total fatality cost for 2006 was $2.4 million. This VSL of $2.4 million will be adjusted for inflation and used in conjunction with the updated fatality data for 2016 to create a hypothetical total fatality cost for 2016. However, this would be relying on the HCA, therefore alternate values for the VSL will be used, as identified in studies from Australian and international perspectives, to provide a range of overall estimates.

The total injury cost element in the 2006 study was $7.14 billion dollars, of which 93.6% was the result of serious injuries and 6.4% minor injuries. Using the 32,300 serious injuries for 2016 calculated by this report, combined with keeping the distribution of serious (12.6%) to minor (87.4%) injuries from 2006 road crashes constant, the estimated number of minor injuries for 2016 is 224,104. For total injury costs in 2016 this report will use the updated injury data in combination with the WTP approach outlined by Hensher (2009) and explored in BITRE (2009).

Property damage costs

The number of registered vehicles in Australia has increased by 26.8% since 2006, which passes on increased demand for insurance and increased operating costs for insurers. This is confirmed by ICA (2017) data, in that claim frequency has risen by 8.6% since 2006, average claim size by 30%, average premium amount by 23.6% and cost per policy by 41.4%. These significant increases have created an increase in insurance administration costs which in 2006 was estimated by BITRE to be $99 per registered vehicle, $125 in 2016 dollars (RBA 2017), meaning that for 18.2 million registered vehicles (ABS 2017c), 2016 insurance administration costs are

- $2.29 billion dollars

For the other major component of property damage costs, vehicle repair costs, this report uses average repair costs. By analysing the ratio of casualties per specific casualty crash from BITRE (2009) and extrapolating for 2016 based on the updated number of fatalities (1,295) and serious injuries (32,300), there were 1,201 fatal crashes, 26,393 serious injury only crashes, 194,839 minor injury only crashes and 453,552 property damage only crashes in 2016. After adjusting for inflation (RBA 2017), the results for vehicle repair costs in 2016 are as follows:

- Fatal crashes only: $10.6 million
- Injury crashes only: $1.78 billion
- Property damage crashes only: $3.75 billion
- Total 2016 vehicle repair costs: $5.54 billion

The remaining 17.8% of property damage/other costs from 2006, such as travel delay costs (see Appendix A), can be adjusted for inflation, equating in 2016 terms to $1.55 billion dollars.

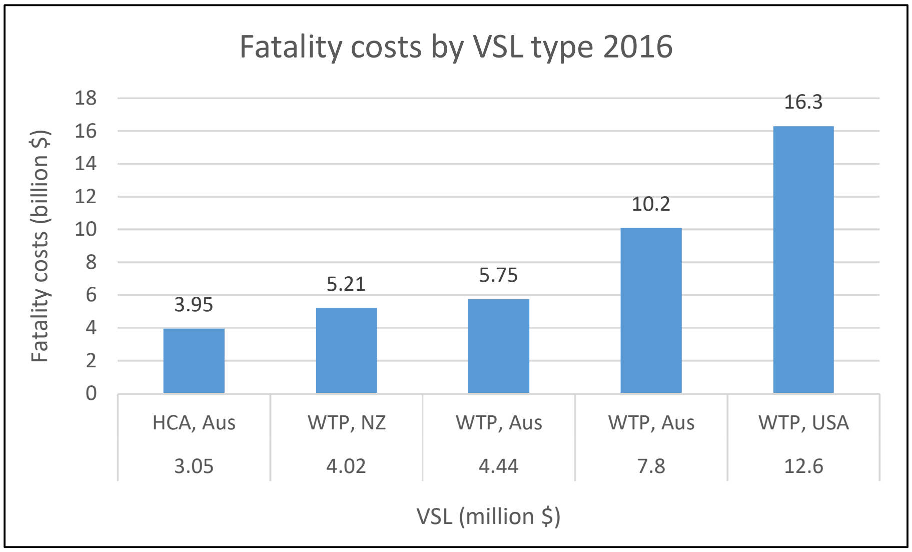
Therefore total property damage costs for 2016 are as follows:

- $2.29 billion insurance administration costs
- $5.54 billion vehicle repair costs
- $1.55 billion other property damage costs
- $9.38 billion total property damage costs, a 36.5% increase over 2006.

Fatality costs

Hypothetically, using a HCA estimated VSL consistent with BITRE (2009) of $3.05 million 2016 dollars, fatality costs are $3.95 billion, which is an increase of 3% on 2006 reflecting the downward trend in fatalities over the last 10 years. Figure 4.1 lists the results for other VSL values in combination with fatality data for 2016. A VSL of $4.44 million 2016 dollars was recommended for Australian institutions by Abelson (2008), while Hensher et al (2009) recommended a VSL of $7.8 million 2016 dollars after doing extensive analysis of over 200 national and international studies. This is the study that BITRE (2009) used on which to base the $27.12 billion total social cost figure for 2006.

Figure 4.1 Fatality costs by VSL type 2016



Sources: Abelson (2008), BITRE (2009), Hensher et al (2009), Ministry of Transport (2017), US Department of Transportation (2015)

This report has used a VSL of $7.8 million to stay consistent with BITRE (2009) and because it has the best research underpinning it, meaning fatality costs for 2016 are:

- $10.2 billion

Injury costs

BITRE (2009) found that using a WTP approach instead of HCA for injury costings increased the result by 44.8% using a framework based on the same study (Hensher 2009) that was used for determining VSL. Applying the 2016 injury data with the average cost of a serious injury of $310,094 and minor injury of $3,057 in 2006 dollars, then updating for inflation, the injury costs for road crashes in 2016 are

- $870 million for minor injuries
- $12.71 billion for serious injuries
- $13.58 billion for total injury crash costs

Out of the complete cost components for serious injuries, the BITRE (2009) distribution was 38% human output losses, 26% disability costs which includes long term carer costs and therapy, and 36% other costs such as emergency services costs, legal costs and non-pecuniary pain/suffering costs. For a full list from 2006, see Appendix A.

Total social cost

The total social cost of road crashes in Australia for 2016 is $33.16 billion.

Figure 4.2 highlights the comparisons with both value of life methodologies used in 2006. The statistic of 2% of GDP sits at the lower end of the 2-5% range identified by ITF (2016) as the standard indicator for countries. It is important to note that $33.16 billion is likely to be a lower bound estimate, because individual preferences examined in the WTP framework are based on data from eight years ago. Current individual preferences on road safety are likely to show slightly higher concern, due to this being the decade for action on road safety fostering greater awareness in the community, and because of the fact that there has been a well-publicised increase in fatalities over the last two years.

Figure 4.2 Total social cost

	Cost component (billion $)				Indicators	
Method	Fatality costs	Injury costs	Property damage and other costs	Total social cost	Total cost per person ($)	Total cost as a % of GDP
2006 HCA	3.84	7.14	6.87	17.85	860	1.7
2006 WTP	9.91	10.34	6.87	27.12	1310	2.6
2016	10.2	13.58	9.38	33.16	1370	2

Sources: ABS (2017a; 2017b), BITRE (2009), Hensher (2009), RBA (2017)

Heavy trucks

BITRE (2009) found that heavy trucks were not contributing to total overall cost as much as other vehicle classes on a VKT basis in 2006.

- 4.8 cents per 1 VKT for rigid trucks
- 4.0 cents per 1 VKT for articulated trucks

Discounting for inflation, the statistics for 2016 are likely to be significantly lower, given that rigid truck involvement in fatal crashes has decreased by 33%, yet their share of VKT has increased by 8%. Articulated trucks show an even better improvement, given that their involvement in fatalities has decreased by 48% since 2006 yet their share of total VKT has only increased by 4%. The initial values of 4.8 and 4 cents per VKT when compared to cars (8.3 cents) and motorcycles (20.2 cents) show that heavy trucks are not damaging society as much as other vehicle types, for the amount of VKT they do a year.

In terms of specific property damage in the trucking industry, using data from BITRE (2009) and updated to 2016 dollars (RBA 2017), the average repair cost for a rigid truck after involvement in a crash is $15,200 and for an articulated truck $39,850. These are significant costs when compared to average cost for a car of only $3800. Based on 2016 data the estimated total vehicle repair costs to the trucking industry from road crashes are:

- $400 million for rigid trucks
- $700 million for articulated trucks

This means that heavy trucks bear 22% of the vehicle repair costs from road crashes in Australia.

5. Safety strategies

Methodology

In 2017 there are numerous road safety measures under development and being implemented across Australia. This report has identified five different avenues of analysis:

- Management/resources
- Leadership/awareness
- Roads/infrastructure
- Technology
- Heavy truck specific

Looking at the most recent studies and implementation reports, as well as select data from overseas, the remainder of this report presents an overview of what is currently being done in each area and how effective the strategies are on reducing the social cost of road crashes.

Management/resources

A BITRE 2014 report found, after interviews with over 400 safety experts, that leadership, management and research were the three most critical road safety measures. In Australia, leadership starts with the Department of Infrastructure at a government level. It is responsible for allocating infrastructure resources throughout the Australian road network and for regulating safety standards for new vehicles, while it also funds select road safety programs. State and territory governments are responsible for funding and operating the roads within their borders, with collaboration from local governments (Department of Infrastructure 2017a).

The ACRS, which is a coalition of road safety interest groups, has lobbied the Federal Government for $5.2 million over three years in targeted road safety measures such as marketing, communication and stakeholder collaboration. $3 million of the total funding is designed to go into creating a National Road Safety Research Framework which would importantly seek to address the problem of national injury data in Australia (ACRS 2017). This report has shown that accurate road crash serious injury data is crucial for analysis of road accident costs, because current estimates vary by the thousands.

The ACRS calls for governmental re-structure due to there being no national road safety or research budget program, nor is there any approved way to record the cost of road crashes for national productivity (ACRS 2017).

The Australian Federal Government has a commitment of $70 billion dollars over eight years from 2013 to fund investment in infrastructure, with a further $75 billion for special road and rail projects from 2017 to 2027 (Department of Infrastructure 2017b). The grouping of road and rail surface transport within the Department of Infrastructure is not necessarily conducive to a focus on road safety initiatives, due to the clear differences in applicability of road and rail safety measures and the low prominence of road safety initiatives within the Department as a whole. This report calls for consideration of a proposal to give roads and road safety initiatives greater prominence and resources by the establishment of a Road Safety Group in the Department, under the responsibility of a Deputy Secretary. In addition to responding to the concerns of the ACRS, this Group would be the vehicle by which to provide leadership, management and research in road safety, identified by BITRE (2014) as the three most important measures to improve road safety.

Leadership/awareness

2011-2020 is the United Nations decade for action on road safety. Australia, like many countries has a National Road Safety Strategy government initiative, which is based on the safe systems approach first championed by global road safety leader Sweden. The NRSS is based on a paradigm shift in safety thinking that acknowledges human mistakes when driving are inevitable. In response, roads and vehicles must be designed to reduce the risk of crashing in the first place and to reduce the seriousness of injuries if they should occur (NRSS 2016). Research by ITF (2016) found that around 30% of serious crashes are caused by deliberate risk-taking behaviour and 70% are caused by errors in judgement from safety-compliant road users. The ITF argues therefore, consistent with the NRSS, that an approach to road safety assuming humans can be faultless road users is wrong, advocating for sustained strong leadership in the move to a safe systems approach based on prevention (ITF 2016).

In Australia the NRSS has set a target of 30% fewer fatalities and serious injuries in 2020 than in 2010. It uses 2008-2010 averages as the base statistic, meaning that a 30% reduction equates to there being at worst 999 fatalities and 23,331 serious injuries in 2020. Using data in this report, with only three years left the fatality reduction is 30% of the way through, while alarmingly the serious injury target has so far made only 10% progress. It is important to note that the previous road safety strategy ending in 2010 fell short of its fatality reduction target and that the reduction rates for 2020 were designed to be realistic (NRSS 2016). This therefore shows that while progress is being made, greater government leadership is required for road safety in Australia.

In terms of road safety awareness, the NRSS has strong collaborations with state, territory and local governments in communication and education strategies. Post-license driver education programs and road awareness training for students, are great examples. Safer speed is a key tenet of the safe systems approach, given that the human body cannot withstand a certain level of crash severity (NRSS 2015). In a Department of Infrastructure survey from 2013, Australians were found to be tolerating and not placing as much importance on the risks of speeding than in the past (NTC 2016). This is concerning given that excessive speed is the cause of at least 30% of road crashes in Australia. The NRSS is focussing heavily on aligning speed limits with the risk of accidents—this is the rationale driving the increase in 40km/h speed zones in high pedestrian areas (OECD/ITF 2016).

From an international perspective the World Health Organisation gives Australia an upper level score for enforcements relating to speed, drink driving, seat belts and helmets, while also finding that there are appropriate policies to promote walking, cycling and public transport use in Australia (WHO 2013). This is encouraging on a global level where there are around 1.25 million fatalities every year (OECD/ITF 2016), but this report has already determined that Australia has slipped in the OECD fatality rankings over the last ten years.

Roads/infrastructure

Safer roads are a key principle of the NRSS. ITF (2016) outlines that assessing risk areas in a road network in order to prioritise safety modifications, is crucial for reducing crashes and casualties. In Australia roads are not designed to be unsafe, but over time as crash data is analysed, some stretches of road and key features such as curvature, median strips and road shoulders become safer than others. The Australian Automobile Association's (AAA) Australian Road Assessment Program (AusRAP) measures the risk rating of major roads across Australia by the number of crashes per length of road and VKT, giving a one (worst) to five (best) star rating (AAA 2016).

Currently 39% of rated roads have a one or two star rating, which is a focus statistic for the AAA. Their aim is by 2020 to have all sections of the National Highway rated 3 stars or higher, with new sections rated 4 star or higher (AAA 2016). In terms of the benefit on the social cost of roads crashes, the AAA found that this task would cost $4.7 billion over 20 years, but would have a benefit-cost ratio of 3.5. In economic terms this is a great investment and it would also reduce the percentage of one and two star rated roads from 39% to 15% (AAA 2015).

The specifics of upgrading the safety of road sections involve road aspects such as the length and radius of curves, the length of the road shoulder, width of median strips and the length of straight road in between two curves. Austroads (2017) detailed the different reduction rates in crashes from different initiatives. Widening the lane length on a curve by half a metre would reduce the number of crashes by around 10%, whereas widening the shoulder width on highways from 0.5m to 1.5m would reduce casualty crashes by approximately 23% (Austroads 2017). The report does not give information on the cost of these procedures and some initiatives would have a negative benefit-cost ratio, such as increasing median width due to the reduction in head on crashes being offset by an increase in rollover crashes (Austroads 2017).

In some instances modifications are not enough and road designs themselves should be changed. As one might expect, reducing the number of curves per ten kilometres reduces the number of crashes, as does increasing the outside shoulder width of curves on two lane highways. After analysing crash results, Austroads (2017) found that a length of straight road in between two curves of greater than 300m gives drivers time to speed. Austroads is considering changing their design rules to recommend an average length of 200m instead of 400m of straight road in between curves on 100km/h roads. This is a great example of the NRSS principle of monitoring and improving road infrastructure, working in practice.

Upgrading the safety of the road network also involves infrastructure such as traffic lights, signage and safer intersections. BITRE (2014) found that roundabouts were generally a good investment for low traffic intersections, with a benefit-cost ratio of 3, which includes negative aspects from traffic delay. An interesting infrastructure development advocated in (ITF 2015b), is self-explaining roads. Advised for areas with high pedestrian use, these are roads that are made to look unusual, but seek to reduce speeding and increase alertness. Features such as distinct road surfaces, prominent landscaping, roadside sculptures or art and even eradication of road markings can all help drivers to reduce speeds and drive to the "look" of the road (ITF 2015b). Pioneered in the Netherlands, the technique reduced casualty crashes by 30% and as such should be at least trialled in Australia.

Technology

Safer vehicles are a key principle of the NRSS. Over time new technologies such as airbags have shown their great effectiveness in reducing the severity of injuries. Budd (2015) found that in the previous decade, fatalities and serious injuries were reduced by 27% due to safety measures like mandating airbags, which has meant that now more than 80% of light vehicles in Australia have driver air bags, a big win for road safety. However, the NRSS now advocates for development of technologies that prevent crashes instead of mitigating their damage. Electronic stability control (ESC), autonomous emergency braking (AEB), fatigue warning systems (FWS) and lane departure warning systems (LDWS) all help to reduce the chance of a crash occurring.

The Australasian New Car Assessment Program (ANCAP) provides evidence based safety ratings for new cars in Australia. Similarly to AusRAP it rates vehicles from one to five based on the injuries sustained by dummies in various crash tests. Cars with solid structural integrity, built-in safety features like ESC and safety assist technologies like LDWS perform better, which is reflected by the fact that a person is twice as likely to be seriously injured in a three star car compared to a five star car (ANCAP 2017a). It takes time for better safety-equipped vehicles to become a significant part of the total vehicle fleet, as new technologies cannot be mandated for old vehicles, however the number of five star rated vehicles has increased by over 50% in Australia since 2010 (OECD/ITF 2016).

ESC is now mandated for new light commercial vehicles made in Australia as well as for all new passenger cars sold in Australia. ESC reduces power and applies individual wheel brakes when the vehicle computer detects a loss of control. Over the decade 2010-2020 and assuming that the rate of vehicles with ESC continues to increase every year, this technology alone will reduce fatalities by 5.7%, equating to 8 lives saved on average every year (Budd, Keall, Newstead 2015).

LDWS and FWS are estimated to reduce fatalities and serious injuries by 0.5% and 3.2% respectively, over the ten year period to 2020. While still significant, the statistics are low due to the limited overall percentage of vehicles fitted with these technologies in Australia. AEB in contrast, has potential to reduce serious casualties by 10% (Budd, Keall, Newstead 2015), with particular effectiveness in lower speed areas. AEB seeks to avoid road crashes by alerting the driver as early as possible to future collisions, lowering the speed before the collision and preparing protective systems for impact. It has been especially effective in reducing pedestrian collisions (BITRE 2014). In terms of cost effectiveness, BITRE (2014) analysis found that mandating AEB in 2018 would save on average 37 fatalities and 1500 serious injuries every year over a 15 year period. Due to the technology being relatively expensive the benefit-cost ratio is low, but still positive at 1.3. This shows that ambitious regulatory decisions can be effective, with human error accounting for 90% of crashes (ANCAP 2017a) having automated safety systems in as many vehicles as possible takes away the chance for mistakes.

6. Heavy truck safety

Regulations

In 2016 the total freight task in Australia was 204.6 billion tonne kilometres. Articulated trucks made up 76.8%, rigid trucks 19.2% and light commercial vehicles 4%, although light commercial vehicles make up 84% of all freight carrying registered vehicles (ABS 2017c). This reflects the amount of weight that can be carried by heavy trucks compared to light commercial vehicles. A rigid truck is defined by ABS (2017c) as:

- Motor vehicles exceeding 4.5 tonnes gross vehicle mass, constructed with a load carrying area. Included are normal rigid trucks with a tow bar, draw bar or other non-articulated coupling on the rear of the vehicle.

An articulated truck is defined by ABS (2017c) as being:

- Motor vehicles constructed primarily for load carrying, consisting of a prime mover which has no significant load carrying area, but with a turntable device which is linked to a semitrailer.

Heavy vehicle safety regulations start with the Australian Federal Government. Currently they have invested $328 million over eight years from 2013 in an initiative to fund projects that benefit the safety and productivity of heavy vehicles across Australia (Infrastructure 2017a). At an implementation level, the National Heavy Vehicle Regulator (NHVR) and the Australian Transport Association's "Trucksafe" scheme set out regulations for accreditation and ongoing compliance in terms of vehicle standards, maintenance standards, training, fatigue management and fitness for duty. Monitoring, updating and ensuring compliance with these rules is essential for continued improvement in road safety. For instance, BITRE

(2016c) found that for fatal crashes with rigid truck involvement, the truck driver did not have a valid license 2.3% of the time and for articulated truck involvement it was 1.6%.

A key issue with measuring the safety performance of heavy vehicle trucks is a lack of useful data. Austroads (2013) argued for the adoption of safety performance indicators to measure useful statistics such as:

- the number of heavy vehicles with NHVR accreditation
- the number of compliance checks undertaken
- the number of trucks caught exceeding the posted speed limit
- the number of rest stops taken for a trip
- the number of heavy vehicles with ESC

The NRSS wants ESC mandated for heavy vehicles, with an effectiveness report under development (NRSS 2016). At the moment ANCAP testing does not extend to trucks, which should be an option for future consideration.

Speed

Heavy vehicle trucks and excessive speed are a destructive combination. 27% of truck crashes in Australia are caused by inappropriate speeding (NTI 2015). There is also distinct community concern about having to share the roads with trucks that speed (NTC 2016). There are two main ways to improve these statistics: deterrence and speed limiter regulations. The NRSS advocates for police to be able to prevent further driving from trucks caught travelling at greater than 15km over the speed limit. However, this proposal was not supported by the National Transport Commission (NTC 2016).

A different alternative argued for by Victorian police is for drivers to be expelled from the accreditation scheme and trucking companies penalised if they own vehicles continually breaking speed limiter levels. A speed limiter is a device that automatically prevents a truck from travelling faster than a certain level, usually 100km/h. NTC (2016) found that tampering with speed limiters was a practice not unknown in Australia, despite the NHVR requiring its use in all trucks over 12 tonnes. This is alarming and led the NTC to consider a proposal of declaring a speed limiter non-compliant if a truck was caught, either by police or from telematics data, travelling at 115km/h. However, due to stakeholder interest it is difficult to create changes to the NHVR laws and the NTC did not recommend this proposal. Therefore, heavy vehicle speeding must be made a priority issue in the NRSS.

Truck driver remuneration

Remuneration is an aspect of heavy truck road safety that deals with drivers being adequately paid for their services. The Road Safety Remuneration Tribunal (RSRT) was set up to ensure that owner drivers have fair work contract conditions and are paid a fixed daily/weekly amount to cover their fixed, variable and labour costs. The rationale for road safety was to reduce the incentive for drivers to take risks in order to get the job done more quickly and easily. The safety averse alternative is load-based and private company-determined payment structures which can indirectly lead drivers to speed, complete insufficient maintenance tests, take insufficient breaks and work unsafe hours, according to a study based on a survey of 559 drivers throughout Australia (O'Neil & Thornthwaite 2016).

The RSRT was abolished in 2016 by the Turnbull Government under a cloud of political debate. One argument was that the increased regulations made owner drivers less competitive in the industry and some were forced out of a job. If one compares this outcome with loss of life and increase in serious injury for not only drivers, but also the wider public, then it is clear which should have more support. The abolition of the RSRT is regrettable for road safety and shows poor leadership at the government level in Australia. NTI (2015) found that fatigue was responsible for 13% of truck crashes, while mechanical faults were the cause of 5%. These are outcomes that the RSRT sought to mitigate. This report argues for an equivalent of the RSRT to again be put on the political agenda.

7. Future concerns

Mobile phone use and driver distraction are becoming an ever growing factor in road crashes. They highlight an example of technology being detrimental instead of assisting the road safety effort. The US Department of Transportation (2010) determined that mobile phone use was a prominent factor in 4% of road crashes. Comparing this to food/drink distraction, which is only 0.75%, shows there is great scope for improvement and a future NRSS should include strategies to reduce driver distraction.

Another key development in the future will be driverless cars. As the level of automated technology increases in vehicles, safety tends to improve, but the impact of fully automated vehicles on safety is not so clear. The technology would continue to reduce the amount of human error crashes, however ITF (2015a) argues that most human driving is relatively crash free and new types of accidents might emerge with widespread use of driverless technology. An example is crashes caused by problems with vehicles handing control back to the driver, or more generally from mixing standard and fully automated vehicles (ITF 2015a).

For the trucking industry and road safety, one future problem might be the rise of the informal land delivery sector. A so-called uberisation of the delivery industry has been noted in the United Kingdom, with light commercial vehicles such as vans bearing more of the freight task. This creates an issue when inexperienced drivers are carrying heavy loads and are not trained well enough in defensive driving (Logistics and Handling 2016). With the freight task being projected to double in Australia over the next 15 years (NTC 2016), this could become a major issue for road safety.

8. Recommendations

On the basis of the findings in this report, it is recommended that:

- The figure of 32,300 serious injuries from road crashes in 2016 be used in cost benefit analyses for Australia, in contrast to previously higher estimates.

- Continued importance be placed on the need to develop a nationally consistent injury recording framework for road crashes.

- The figure of $33.16 billion be used as the latest estimate for annual total social cost of road crashes in Australia.

- The Australian Federal Government create a Road Safety Group within the Department of Infrastructure.

- Greater emphasis be put on addressing the link between heavy trucks, speeding and road safety, as well as heavy truck driver remuneration and road safety.

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Appendix A

Estimated social costs of road crashes in Australia by cost element 2006, reproduced from BITRE (2009).

Cost element	Human related costs: Fatalities ($millions)	Human related costs: Hospitalised injuries ($millions)	Human related costs: Non-hospitalised injuries ($millions)	Property damage and general costs ($millions)	Total crash cost ($millions)	Proportion (per cent)
Workplace and household losses	3007.2	2 573.9	108.9	na	5 690.0	31.9
Repair costs	na	na	na	4 227.5	4 227.5	23.7
Disability-related costs a	na	1 863.9	na	na	1 863.9	10.4
Non-economic or non-pecuniary costs	728.3	1 039.7	na	na	1 768.0	9.9
Insurance administration	13.2	256.5	na	1 421.3	1 691.0	9.5
Medical and related costs	3.4	511.4	349.5	na	864.2	4.8
Travel delay and vehicle operating costs	na	na	na	839.7	839.7	4.7
Legal costs	36.5	231.3	na	na	267.9	1.5
Vehicle unavailability costs	na	na	na	214.1	214.1	1.2
Emergency and police services cost	7.6	62.6	na	72.9	143.1	0.8
Work place disruption	10.3	77.7	na	na	88.0	0.5
Ambulance	3.6	59.9	na	na	63.5	0.4
Health cost of crash-induced pollution	na	na	na	53.4	53.4	0.3
Street furniture damage cost	na	na	na	40.2	40.2	0.2
Correctional services	15.3	na	na	na	15.3	0.1
Recruitment and re-training	6.6	2.5	na	na	9.2	0.1
Premature funeral cost	7.2	na	na	na	7.2	0.0
Coronial costs	3.1	na	na	na	3.1	0.0
Total	3 842.4	6 679.5	458.3	6 869.1	17 849.3	100.00