

Road Related Quad Bike and Side by Side Vehicle Casualties

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Abstract

Quad bike vehicle related casualties continue to be a leading contributor in regards to fatal and serious injuries occurring in Australian rural areas, particularly on farms. Side by Side Vehicle (SSV) incidents also contribute to rural casualties albeit to a much lesser extent. Despite significant attention, little progress has been made in reducing their incidents or severity, and indeed they appear to be increasing. An investigation of closed cases in the National Coronial Information System (NCIS) for the period 2000 to 2012 identified 141 fatal cases. Of these sixteen or around 11% of all fatalities involved a fatality on a public road. Little is known about the characteristics of these public road related fatalities. The authors are not aware of any publications regarding Australian casualties. However, some data regarding Victorian road related Quad bike and SSV serious injuries have been published. Data has been collected for NSW and other states by two of the authors.

In some countries, such as Sweden and parts of the USA, such vehicles are permitted to travel on public roads. A question that has arisen for Australian regulators is whether these vehicles should be permitted to travel on Australian roads and if so under what circumstances. In order to understand the risk and form a road safety policy position regarding these vehicles it is important know what the magnitude of the problem is and how people are being injured and killed in the road environment. This paper presents an overview of the statistical data and characteristics of the road related Quad bike and SSV crashes in Australia. Recommendations concerning these vehicles roadworthiness are also presented.

Introduction

In Australia, it is estimated that there were approximately 270,000 Quad bikes and SSVs in use in 2010 (Mitchell, 2014, Australian ATV Distributors, 2010). This compares to an estimated 80,000 Quad bikes and SSVs in use in New Zealand agriculture in 2010 (Carman et al, 2010) and an estimated 10 million Quad bikes and SSVs in use by 16 million individuals in 2008 in the United States (US) (Mitchell, 2014, Helmkamp et al, 2011).

The use of Quad bikes and Side by Side Vehicles both recreationally and in the workplace, continue to be major contributors to fatal and serious injuries in the USA, Australia and Europe. The authors have found from their analysis of Coronial data that a portion of the fatal incidents (around 11%) are fatalities that occurred on public roads (McIntosh A.S. and Patton D., 2014). Little is known about the characteristics of these public road related fatalities. The authors are not aware of any publications providing any information regarding Australian Quad bike casualties as a whole. However, some data regarding Victorian road related Quad bike casualties have been published (Claperton, 2013). This paper presents an overview of the statistical data and characteristics of road related Quad bike and SSV crashes in Australia.

Before discussing Quad bike and Side by Side Vehicle (SSV) casualties, some discussion is necessary concerning the use of terminology to describe these vehicles in Australia and in particular the use of the term 'All-Terrain Vehicles' (ATVs) elsewhere, e.g. North America and Europe. In Australia, the term for vehicles commonly used on farms over rougher terrains is Quad bikes (Figure 1) or Side-by-Side Vehicles (Figure 2) depending on their size, how they are operated and the farming task.



Figure 1: Quad bike similar to motorcycle regarding vehicle operation, that is operator sits in straddle position, using handlebars to steer vehicle, throttle is usually on the right arm of the handlebar and brakes are on both sides of the handlebars.



Figure 2: Side by Side Vehicles

Quad bikes are distinguished from SSVs in Australia by their design, namely the Quad bike's straddle seating, steering via handlebars with a small thumb operated throttle on the right side and low pressure tyres. This compares to the SSV's operator configuration which is more akin to a traditional car where seating is upright, a steering wheel is used to direct the vehicle, brakes and accelerator are operated by the drivers right foot and wheel tyre pressures are higher. The SSVs shown in Figure 2 are also referred to as Recreational Off-Highway Vehicles (ROHVs) in the USA. Another term sometimes used in the USA for SSVs is Utility Task Vehicle (UTV). SSVs are distinguished from various larger four wheel drive or sports utility vehicles (SUV) off-road vehicles by their limited width, limited gross vehicle weight rating and limited engine capacity. However, the term All-Terrain Vehicle or ATV is sometimes used in Australia inadvertently to describe a SSV. A more recent development in Europe has seen the term Quadricycle used to describe small 4 wheel light city vehicles some which look like a traditional vehicle but some vehicles look like a SSV (Persson, 2013, EuroNCAP, 2014). However, the term Quad bike in Europe has a broader definition than in Australia (Persson, 2013).

More recently, European Union (EU) vehicle safety regulations have included Quad bikes and SSVs in the requirements for Type Approval for on-road use, grouped under the generic term Quadricycle, which more commonly refers to lightweight and low power/speed vehicles used for local delivery door to door as a local 'shopping car'. Without Type Approval, these off road type vehicles cannot be ridden on public tracks, trails and pathways, (even through forests) all of which are categorised as part of the road for the purposes of this regulation. Of key importance, from 2016, these vehicle types will be required to be fitted with an open rear differential to permit steerability and control on firm ground, a critical safety issue.

One potential confusing factor in Australia is the continuing use of the terms 'Quad', 'Quad bike', 'ATV' and 'All-Terrain Vehicle' by the media, by accident investigators, by Coroners, and by others, which has often been used to refer to both Quad bikes and Side-by-Side Vehicles. There are two industry voluntary standards used in the United States of America (USA): the American National Standards Institute (ANSI) and Specialty Vehicle Institute of America (SVIA) voluntary industry standard ANSI/SVIA 1-2010 for Four Wheel All-Terrain Vehicles (SVIA, 2010); and the ANSI and Recreational Off Highway Vehicle Association (ROHVA) voluntary industry standard ANSI/ROHVA 1 – 2011 for Recreational Off-Highway Vehicles (SVIA, 2011). The terms are explained in these documents.

Regardless, both an Australian Coroner and the USA Federal Government's Consumer Product Safety Commission (CPSC) have indicated that the term 'All-Terrain Vehicles' is misleading and may result in false assumptions as to the terrain that such vehicles can safely traverse (Olle, 2009, Elder and Leyland, 2006). Hence, there is considerable resistance by Australian safety stakeholders to the use of the term All-Terrain Vehicles or ATV. The focus of this paper is for Australian readers, therefore, the authors will refer throughout this paper the term Quad bikes to represent those vehicle types shown in Figure 1 and SSVs for those vehicles shown in Figure 2 unless otherwise indicated in the text.

Australian researchers and authorities have identified Quad bike rollovers are the major cause of fatalities in Australia, with crushing of the rider by the Quad bike, or ejection with impact with the ground or objects being the primary injury causal mechanism (Grzebieta et al., 2014). McIntosh and Patton (2014) identified around 141 fatalities over a period of around 12 years (2000-2013), averaging around 10 to 15 fatalities per year where approximately 50%

are work related and 50% are recreational. Most serious incidents occur in agricultural settings (Rechnitzer et al, 2003, Rechnitzer, 2012). Of the farm workplace related fatalities in around 85% of cases, rollover has been identified as the primary causal mechanism.

In response to the incidence of fatal and serious injury rollovers involving Quad bikes in the farming sector, and lack of any industry response to provision of rollover protection systems on Quad bikes, Crush Protection Device (CPD) systems have been recommended by various Quad bike safety stakeholders. Nevertheless, the vehicle manufacturers continue to maintain that such systems are hazardous (FCAI, 2014, Rechnitzer, 2012). To help overcome this ‘impasse’ in progressing Quad bike rollover crashworthiness safety, the WorkCover Authority of New South Wales (Australia) funded the Quad Bike Performance Project (QBPP). This major project, strongly supported by the State Government of New South Wales (NSW), is based at the Transport and Road Safety (TARS) Research unit at the University of NSW, with the project led by the authors of this paper (Grzebieta et al, 2014).

The Project was aimed at addressing Part 7 of the Heads of Workplace Safety Authorities (HWSA) and the Quad Bike Industry Working Group Strategy (Design) for improving the safety of Quad bikes, in the farm environment. It included a review of Australian Quad bike and SSV fatality and injury data for the period 2000 to 2012 and an extensive test program on seventeen vehicles (both Quad bikes and SSVs) investigating their Static Stability, Dynamic Handling Stability and Rollover Crashworthiness. Discussions and the outcomes from those tests have been reported elsewhere (Rechnitzer, 2012, Mongiardini, 2014, Grzebieta et al, 2014). However, from the investigation of the 141 fatality cases collected it was observed sixteen (16) or around 11% of all fatalities involved a fatality on a public road which were excluded from the 109 fatalities investigated in detail (McIntosh and Declan, 2014). This paper focusses on the analysis of those 16 incidents. As mentioned earlier, the authors are not aware of any publications presenting an overview of all Australian casualties involving Quad bikes and SSVs fatalities on public roads. It is important to assess the circumstances under which riders are killed and consider whether such vehicles be allowed to travel on public roads at all.

Quad bike and SSV Fatalities on Public Roads

The main reason for investigating fatalities and injuries that have occurred on public roads is because of the recent activity in Europe and in parts of the USA and the rising demand that could potentially flow through to Australia. Because of rising fuel costs Quadricycles, Quad bikes and SSV vehicles are sold as a convenient, economical means of transport.

Quadricycles, which appear to be more akin to a small commuter car, are being used in city urban areas. However, alternate forms such as SSVs and Quad bikes are being considered for use in rural areas on public roads (Figure 3). They can be driven on some European roads legally and a full licence may not be required to drive them (Figure 3), although the current requirement is for a B1 category license (car) that has a minimum age of 17 years. The European Union has technically classed such vehicles as Light Quadricycles (L6e) (categorises the youth model quad bike) or Heavy Quadricycles (L7e) (categorises the adult agricultural or recreational quad bike and SSV). Moreover, these vehicles do not have to pass the stringent safety tests that apply to normal passenger cars, although consumer pressure to improve the safety of these vehicles is progressively being applied. For example, the European New Car Assessment Program (Euro NCAP) has recently tested four Heavy Quadricycles (EuroNCAP, 2014).



Figure 3: Quad bike on road in The Netherlands
 (source: Wikipedia, All Terrain Vehicles, Photo: Johannes J.)

In the USA, 35 states (69%) now either allow Quad bikes or SSVs on certain roads, in some form or another (Weintraub, 2014, Williams et al, 2013). Figure 4 is reproduced from the Consumer Federation of America of data compiled from data collected by the Insurance Institute of Highway Safety (IIHS) where it shows that the number of ATV deaths on road in the USA is increasing at a faster rate than those off road. Moreover, IIHS analysis of FARS (Fatality Analysis Reporting System) fatality data indicates that 56% of these fatalities on roads involved a rollover. The main reasons why some local regulators have allowed these

vehicles to travel on public roads has been mainly for convenience in rural areas particularly for older people who may have mobility issues, providing farmers right of way access to other property, children who are not able to drive a registered vehicle, and particularly where enforcement is not clear.

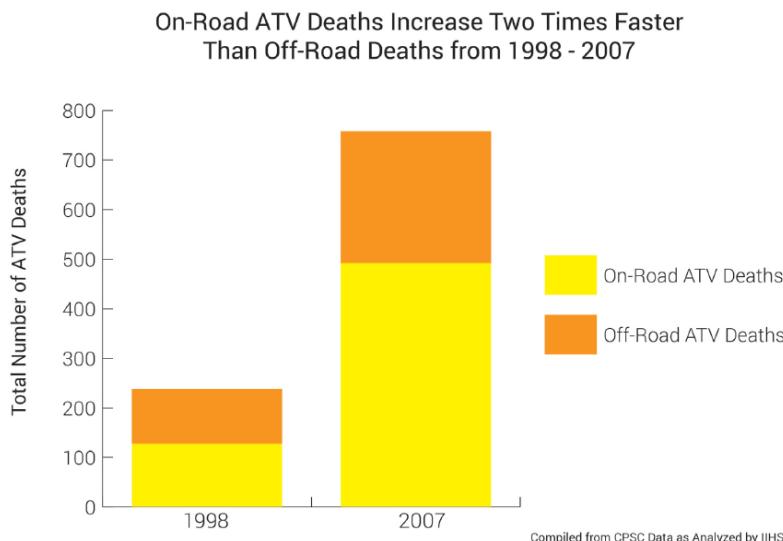


Figure 4: USA ATV fatalities comparing 1998 data with 2007 data from Weintraub, 2014 and Williams et al., 2013

Nevertheless, there is uniform agreement between safety stakeholders and industry in Australia that Quad

bikes and SSVs should not be permitted to travel on roads, beyond current controls and exemptions (e.g. crossing a road at farms etc.).

European data is scant though there is close monitoring of data in Sweden (Persson, 2013). Sweden has recorded 74 fatal incidents of which 27 occurred off-road and 47 on-road involving either a Quad bike, Quadricycle, or SSV over the period of 2001 to 2012. The number of on-road fatalities and serious injuries in Sweden, being higher than non-road fatalities, is steadily rising. The number of hospital reported non-fatal injuries reported for these vehicle over the period of 2007 to 2010 was around 7000. Of those admitted to hospital 40% were children under the age of 15.

Persson investigated 42 of the on-road fatalities and found: 70% of the vehicles involved in fatal incidents were quad-bikes; 60% drivers/riders killed were under the influence of alcohol; head injuries accounted for more than half of the fatal injuries; 70% involved a rollover; 33% had the vehicle on top of them at some point during the incident; and in 20% of the cases the victims were discovered still under the vehicle. For the 27 off-road fatalities: 60% of the vehicles had overturned; 56% were trapped under the vehicle; 15% received head injuries; 26% received chest injuries; 19% drowned (a majority fishing on iced over lakes).

Notably, registration is required in Sweden for on-road travel and all Quad bikes and SSVs must have third party traffic insurance regardless of whether the vehicle is registered or not.

Australian Data

Methodology

Australian data of on-road fatalities for Quad bike and SSV users was collected by McIntosh and Patton (2014). After obtaining ethics approval, the NCIS system was initially searched for closed fatal Quad bike and related vehicle cases, during the period 2000 to 2013, using a Boolean combination of the following search terms: “quad bike”, “quadbike”, “quad-bike”, “ATV”, “all terrain”, “all-terrain”, “off road”, “off-road” and “vehicle”. In addition, a second search was conducted using the object section of the National Coroners Information System (NCIS) query design to select: category 1, “mobile machinery or special purpose vehicle”; category 2, “other mobile machinery or special purpose vehicle”; description, “special all-terrain vehicle/off-road vehicle, quad bike”. The case lists returned from the two search strategies were collated and compared to the Register of Quad Bike Deaths from the National Farm Injury Data Centre (NFIDC), which is maintained by the Australian Centre for Agricultural Health and Safety (AgHealth), which in turn sources their data from NCIS and daily Media Monitors programme alerts.

Individual case files were then retrieved from each State and Territory. All cases were reviewed with a focus on the characteristics related to the individual, temporal factors, vehicle, environment, crash and injuries. For this study, fatalities that only occurred on public roads were analysed and are presented here.

Results

A total of 141 closed fatal cases were identified to have involved a quad bike or SSV and reported to Australian coroners between 2000 and 2013.

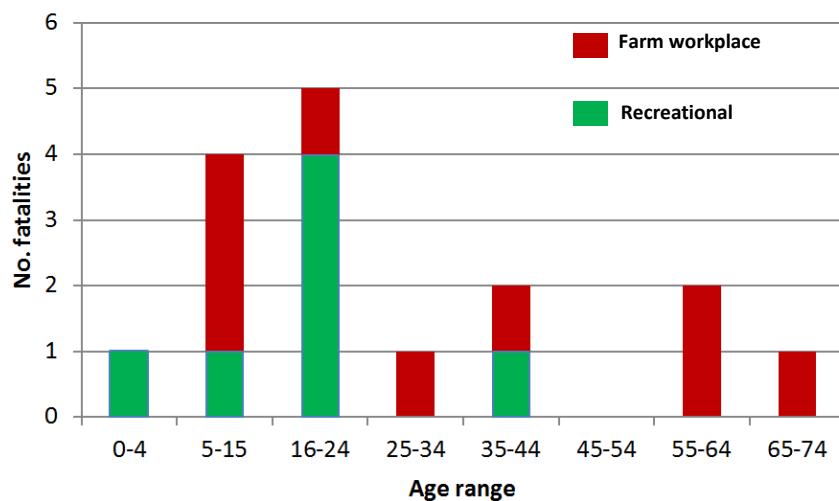
A total of 16 fatalities (from 141), around 11%, were identified as having occurred on a public road, averaging a little over one per year. Two of the vehicles were SSVs and the remaining 14 were Quad-bikes. In contrast to European and US experience, all fatalities were rural, that is no fatal incident was recorded in an urban environment.

The distribution for the various states and territories is shown in Figure 5. The two most populous states have recorded 4 fatalities. Interestingly, no on-road fatalities were recorded for Queensland over the study period. Figure 6 shows the age range and purpose of use, that is recreational or workplace. All workplace incidents were related to a farm. There were 9 workplace farm fatalities compared to 7 recreational related fatalities.

State	No. fatalities	Year
NSW	4	2x03, 05, 06
Vic	4	06,07,08,09
SA	2	2x05
WA	2	02, 04
Tas	2	09, 10
ACT	1	11
NT	1	10
Qld	-	-



Figure 5: On-road Australian fatalities for each State (2000 – 2012), n=16



**Figure 6: Australian fatalities on public roads 2000-2012 (n=16)
segregated according to age and use.**

In regards to other characteristics such as helmets, collisions, crossing roads, passengers, etc. Figure 7 presents a summary of these results. There were 12 males (75%) and 4 females killed of which 7 were passengers (44%) and one rider who died was carrying a passenger, totalling 8 vehicle fatalities where a passenger was carried (50%). In regards to the eleven Quad bikes/SSVs that collided with another vehicle (69%) the other vehicles were: train (n=1), cars (n=4), four wheel drive / Sports Utility Vehicle (n=3), two-wheel motorcycle (n=1), heavy truck (n=1), and bus (n=1). Twelve of the riders did not wear a helmet (75%), 2 were known to have worn a helmet and in 2 cases it was unclear whether a helmet was worn. Three cases involved alcohol (0.03, 0.08, 0.101).

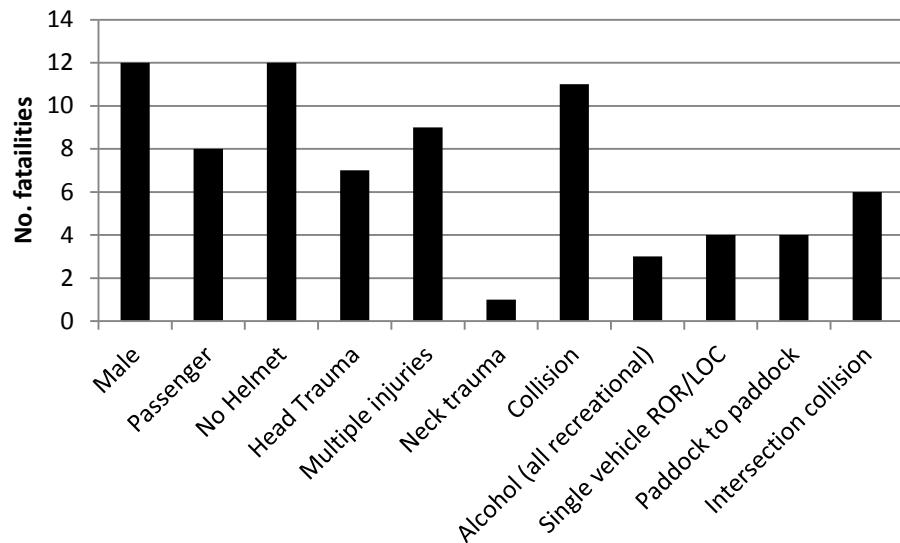


Figure 7: Characteristics of the Australian on-road Quad bike and SSV fatalities (multiple factors shown, 16 fatalities in total)

The nature of the on-road fatalities was either recreational or in a workplace environment but all were in a rural environment. Riders (with or without passengers) were either: crossing the road from one paddock to another ($n=4$); travelling along a road (either private or public) and then crossing a public road that intersected the road they were travelling on ($n=6$); travelling along a public road and lost control (loss of control – LOC) running off the road (ROR) and colliding with roadside hazard such as tree or colliding with another vehicle. ($n=4$). In contrast to Sweden's on-road casualties, there were no rollover related incidents. With respect to trauma, 7 sustained serious head injuries (44%), 9 received multiple injuries (56%, combination of head, chest, limbs, etc.) not dissimilar to what is commonly observed in serious motorcycle crashes, and in one case the rider suffered serious neck trauma.

Conclusions and discussion

Investigation of Australian Coronial data for the period 2000-2012 has revealed that 16 people have been killed using a Quad bike or SSV on a public road, that is around 11 % of all Quad bike and SSV fatalities or a little over one per annum. Almost half of those killed were passengers riding. The Quad bike related incidents ($n=6$) were on single rider only vehicles. Riders are predominantly male, not wearing a helmet, usually in a situation where the vehicle collides with another vehicle and the riders are ejected and hit an object, receiving multiple injuries not dissimilar to riders receiving injuries in serious motorcycle crashes. All have occurred in a rural environment. So far no fatalities have occurred that involve commuting. The number of incidents are related to a farming workplace is slightly greater than recreational use.

In Australia, Quad Bike and SSV usage on road is quite restricted by regulation, with fatalities and serious injury on-road crashes involving Quad Bikes and SSVs being small in comparison to all road fatalities ($\approx 0.01\%$). As a result, in the cases where fatalities have occurred, the vehicles appear to have been operating within the intent of the regulatory constraints. In other words, the vehicles were traversing from a private property (farm) or off-road environment across or along a public road to access another private property or off-road area, even though the vehicle was not registered for such access to a public road. This

contrasts with Europe and the USA where Quad bike and SSVs are permitted far greater on-road usage not only for private property access purposes but also for commuting. Weintraub and Best (2014) and Williams et al (2013) highlight how Quad bikes and SSVs are not intended for on-road use and have design features that can increase risk because of the low tyre pressures when operated on paved surfaces at speed, that is loss of control and run-off-road and rollovers when cornering. Moreover, there is a complete mismatch in terms of crash compatibility between these vehicles and traditional on-road vehicles. This has now resulted in higher on-road fatality rates than in off-road usage in the United States.

Head trauma is preventable through the use of an appropriate helmet. An appropriate helmet may have prevented head trauma in seven of the fatal cases included in this analysis. Currently there is no mandatory law to wear a helmet when riding a Quad bike in Australia. The industry, regulators and safety advocates recommend that Quad bike riders (and passengers) wear a helmet at all times. Similarly, there is no Australian standard specifically for helmets for Quad bike riders and it is recommended that Quad bike riders wear an AS/NZS 1698 compliant helmet as worn by motorcyclists. There is a New Zealand standard for Quad bike helmets (NZS 8600:2002) that is not consistent with the demands of AS/NZS 1698 and would currently not comply with road rules, in contrast to AS/NZS 1698 helmets. A challenge exists to supply helmets that are comfortable and suitable from both ergonomic and safety perspectives for Quad bike operators without compromising compliance with road rules, for those who cross or ride along public roads. The opportunity exists for helmet suppliers to consider these performance requirements and produce a light-weight helmet that satisfies this safety need.

In Europe on-road usage of these vehicles types is on the increase due to low purchase and running costs (and possibly claimed ‘environmental’ benefits), and convenience for some older and young riders seeking better mobility at a much lower affordable price. Such vehicles and other somewhat similar types , designated as ‘Quadricycles’, do not have the crashworthiness of modern passenger vehicles, with EuroNCAP now starting modified NCAP type testing for ‘Quadricycles’. The likely outcome is an increasing toll from on road crashes involving Quad bikes, SSVs and Quadricycles.

Key to the EU regulation is the introduction of open rear differential from 2016 to improve steer-ability and control, following the number of loss of control crashes on road. Three of the 16 Australian fatalities noted in this paper were the result of such dynamic instability. While vehicle manufacturers argue Quad bikes cannot be driven on hard ground, most tracks and trails in Europe (and in Australia) have some form of bitumen or paved surface connecting or leading to them and car parks or local towns/villages or the vehicles are used on such roads. Importantly, the EU regulation only applies if Type Approval is sought for on-road use. Manufacturers can still make and sell the traditional Quad bikes but they cannot be used anywhere except on fully enclosed, private property.

It is likely that similar pressures will occur in Australia to reduce current strict constraints on the on-road usage of Quad bikes, SSVs etc., and the newer ‘Quadricycles’.

The key conclusion is that Australian Road Safety authorities must carefully monitor and evaluate this trend occurring in Europe and the USA, and ensure that current restrictions on the on-road usage of Quad bikes, SSVs and the newer Quadricycles are not permitted to be watered down under possible “political pressure”, but only in the case where the vehicles,

licencing, registration and usage can demonstrate compliance with ‘Safe System’ approach principles and requirements.

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