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NON-REGISTERED MOTORISED VEHICLES

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Transport and Road Safety (TARS) Research Submission to The Staysafe Committee Inquiry into Non-Registered Motor Vehicles

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The submission is split up into two sections; one section focusses on Motorised Mobility Scooters and the other section on ATVs (Quad Bikes and Side by Side Vehicles). Sections focussing on Motorised Mobility Scooters were prepared by Dr Boufous and sections focussing on ATVs were prepared by Prof. Grzebieta, Dr. Mitchell and A/Prof. Rechnitzer.

Quad Bikes and Side by Side vehicles (All Terrain Vehicles or ATVs)

The current status of non-registered motorised vehicles in road rules definitions and the extent of road safety problems related to their use

Before presenting material on ATV safety, some discussion is necessary concerning the use of the terminology 'All Terrain Vehicles'. In Australia, depending on their size and farming task, the term for vehicles commonly used on farms over rougher terrains is Quad-Bikes where the driver straddles the vehicle similar to a motor-cyclist (Figure 1a), or Side by Side Vehicles (Figure 1b) where the rider and passenger sit in the vehicle similar to a road vehicle. Both an Australian Coroner and the US Consumer Product Safety Commission have indicate that the term All Terrain Vehicles (ATV) is misleading and may result in false assumptions as to the terrain that Quad-Bikes and Side by Side vehicles can safely traverse *[i*, [ii]]. Nevertheless, while the authors sympathise with this perspective, throughout this submission the term ATVs is used to will be used to represent Quad Bikes unless otherwise indicated in the text that the ATV vehicle is a Side by Side.

There is an estimated 220,000 quad bikes in Australia with an estimated 80% being used in rural industries. The use of ATVs both recreationally and in the workplace (particularly on farms in Australia), continue to be major contributors to fatal and serious injuries both in Australia and overseas, i.e. the USA. There were 18 fatalities that occurred in Australia in 2012 [[iii]]. On average there appears to be around 3 to 4 ATV fatalities occurring each year in NSW though the number fluctuates widely from one year to the next. For example, there have been already been 5 ATV related fatalities that have occurred in NSW this year (2013). However, it should be noted that nearly all incidents occur off-road on private properties and forest and park trails [[iv]]. Few occur on public sealed and unsealed roads although in the USA deaths and injuries on public roads appear to be a significant contributor to their casualty count. Moreover, US fatalities and injuries appear to be more recreational related.

a) Quad Bike b) Side by Side

Figure 1

Lower et al [iii] presented data on the 127 quad bike deaths in Australia between 2001 and 2010: "*It examines differences between causes of death occurring through use of the machine in farm/non-farm settings and during work/non-work operation. Data were extracted from the National Coroners' Information System (NCIS). In total, 65% of fatalities occurred on-farm, with 45% of incidents being work-related and 46% involving rollovers of the quad bike."*

The report notes that *"A study of trends in farm deaths in Australia found that while deaths from tractor rollovers had decreased by 74% between 1982–84 and 2001–04, deaths associated with quad bikes had increased nearly 13-fold. ... Massive increases in occupationally related incidents have also been reported in the United States of America (USA)".*

Lower quotes USA data *"Between 2000 and 2007 in the USA there was an average of 723 deaths per annum attributed to quad bike use."*

In regard to injury mechanisms, rollovers predominate [iii]: *"Analysis of the nature of the crash event highlights the leading mechanisms of injury as: collision with stationary object (34), rollover with no load or attachments (33), collision with other vehicle (10) and rollover with spray tank (9). Rollover of the quad bike attributed to 46% of all deaths where the mechanism of injury was known. Additionally, where the work status and mechanism were known, rollovers accounted for 58% of deaths."*

The report identifies the incidence of thorax injuries and asphyxia in rollover cases, and the potential benefits of Crush Protection Devices [CPDs] for prevention: The

significant variation in the primary cause of death between rollover and non-rollover events is a crucial finding. With 53% of rollover deaths involving the thorax, asphyxiation and drowning alone, the potential benefits of any crush protection device to prevent entrapment are clearly apparent. In addition, it can be reasonably contended that a sizeable number of head (24%), neck (14%), abdomen (4%) and multiple injuries (4%) incurred in rollovers could be averted by such a device".

To help progress ATV safety, the WorkCover Authority of New South Wales (Australia) has funded the Quad-Bike Performance Project. This major project is also strongly supported by the State Government of New South Wales (NSW) and was recently launched by Minister Gregory Pearce. The project is based at the Transport and Road Safety (TARS) Research unit at the University of NSW. The project is being led by Professor Raphael Grzebieta and Associate Professor George Rechnitzer and involves team members Dr. Rebecca Mitchell, Adjunct Associate Professor Andrew McIntosh, Mr. Keith Simmons, Dr Tim White (from Dept. of Mechanical Engineering), Dr. Jake Olivier (from School of Mathematics and Statistics), Mr. Declan Patton and Mr. David Hicks. All testing is being carried out at the Roads and Maritime Services Crashlab test facility being led by Mr. Ross Dal Nevo and assisted by Mr. Drew Sherry. The project commenced in September 2012, with completion towards September 2013.

The project aims are to establish stability, dynamic handling and crashworthiness ratings for the selected Quad-Bike and Side by Side models and to develop an ANCAP type testing and rating system (New Quad-bike Assessment Program or NQDAP) for rollover stability, handling and crashworthiness. This is explained further on in this submission.

Injury and fatality data will be collected as a component of this project using the data sources outlined in the next section and will be reported later in the year to the NSW WorkCover Authority. One of the areas of concern raised by the preliminary analysis of the data is the significant portion of riders killed and injured are children under the age of 16.

The adequacy of data collection for injury and fatality rates arising from the use of all-terrain vehicles

There are a number of data collections in New South Wales (NSW) that have the ability to provide information on injury and fatality rates as a result of incidents involving all-terrain vehicles (ATVs), or quad bikes, on public roads or private property. These include: WorkCover NSW Workers' Compensation Scheme Claims, WorkCover NSW Inspector's

Reports, the NSW Admitted Patient Data Collection, the NSW Near Real-time Emergency Department Surveillance System, Transport for NSW's CrashLink/Road Crash Analysis System data collections, and the National Coronial Information System and through coronial files.

WorkCover NSW Workers' Compensation Scheme Claims Data

WorkCover NSW's workers' compensation scheme claims data includes information on work-related deaths, injury and disease (excluding dust diseases) claims of workers employed in NSW. Information recorded in the workers' compensation claims data includes: details of the claim, incident and employer; the claim activity; the claimant's time lost from work; services provided to the claimant; and the actual and estimated compensation payments and recoveries relating to the claim. The claims data are classified using the Type of Occurrence Classification Scheme (TOOCS) [v, vi]. The TOOCS agency code for ATVs was introduced in TOOCS version 3. Information in the NSW workers' compensation claims data has been classified using the TOOCS version 2 and was recently updated to TOOCS version 3 [v, vi].

To currently identify trends in work-related injuries involving ATVs in the WorkCover NSW workers' compensation scheme claims data collection, ATVs can be identified if the agent of injury or the breakdown agent of injury was identified as an ATV/ quad bike (TOOCS agent: 2929) OR through searches of the incident description to identify keywords: 'ATV', 'all terrain vehicle', 'quad', 'quad bike', 'farm quad', 'farm utility vehicle', 'farm utv', or '4 wheeler'.

WorkCover NSW Inspector's Data

Incidents can be notified directly to WorkCover NSW or via a workers' compensation claim. For some incident notifications no physical inspection was undertaken. When an incident is notified to WorkCover NSW a determination is made based on the available information whether the issue requires some action by WorkCover. In investigating an incident there may be no actual visit/inspection needed.

Information recorded includes the date of the incident, demographics of the injured, and a description of the incident. If an investigation has been undertaken, an investigation report will also be available. The text descriptions may allow the extraction of the following information: the type of quad bike, whether the activity was for work or recreation, the ground surface, whether the injury involved the operator or passenger, whether a roll over

protective structure (ROPS), restraints or helmets were present or worn, whether there was a front or rear load or any attachments, and injury outcome. To identify ATV incidents in the WorkCover NSW Inspector's data text narrative descriptions are required to be searched for keywords, such as: 'ATV', 'all terrain veh', 'all terrain veh', 'quad', 'quad bike', 'quadbike' or 'quad-bike'.

NSW Admitted Patient Data Collection

Data from the NSW Admitted Patient Data Collection (APDC) include information on inpatient separations for individuals from public and private hospitals, private day procedures, and public psychiatric hospitals. The APDC contains information on patient demographics, source of referral, diagnoses, external cause(s), separation mode and clinical procedures. Each health record relates to individual episodes of care in hospital, which end with the discharge, transfer, or death of the patient, or when the service category for the admitted patient changes. Diagnoses and external cause codes are classified using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) [vii].

All terrain vehicle-related hospitalised injuries are able to be identified through the external cause code: 'occupant of special all terrain or other motor vehicle designed primarily for off-road use, injured in transport accident' (i.e. ICD-10-AM range: V86.0 to V86.9). In 2003-04, enhancements were made to the ICD-10-AM classification framework to identify the number of wheels on the all-terrain vehicle using a 5th character. In theory, ATV-related hospital admissions are also able to be identified using an activity classification (i.e. ICD-10-AM: U65.0), however the data quality of activity classifications in the APDC is relatively poor.

NSW Near Real-time Emergency Department Surveillance System

The majority of public hospital emergency departments (EDs) in NSW collect information on patient presentations using the Emergency Department Information System (EDIS), a patient administration and clinical data collection system [viii]. Information from EDIS is then conveyed by Local Health Districts (LHD) to the NSW Ministry of Health via computer networks.

Data items recorded in NSW Near Real-time Emergency Department Surveillance System (NREDSS) include: patient age, gender, postcode of residence, arrival date and time, triage category, visit type (e.g. emergency, planned, or unplanned return visit), mode of

arrival (e.g. ambulance, private vehicle), country of birth, provisional diagnoses, hospital code, departure status (e.g. discharged, admitted to hospital, transferred, or died), free-text presenting problem (e.g. lacerated finger), and free-text triage nurse assessment. The provisional diagnosis is allocated by ED clinical staff via keyword searching and selection of the most relevant diagnosis.

To identify ATV-related ED presentations, a free-text search of the triage notes needs to be conducted using key words.

Transport for NSW CrashLink/Road Crash Analysis System

The CrashLink collection is administered by Transport for NSW and contains information on all police-reported road traffic crashes where a person was fatally or non-fatally injured in an unpremeditated event (i.e. unintentional) or at least one motor vehicle was towed away and the incident occurred on a public road in NSW. Information from the CrashLink data collection that was provided to the study investigators was for killed or injured individuals only. Information recorded in CrashLink includes: information describing the crash and conditions at the incident site; information regarding the traffic unit or vehicle and the vehicle controller; and information describing any casualties resulting from the crash.

Transport for NSW is able to identify some fatal ATV-related crashes that occurred on public roads and for some private properties if the incident is reported to police. To identify ATV-related crashes, a free-text search needs to be conducted using key words.

National Coronial Information System

The National Coronial Information System (NCIS) is a national computerised data storage and retrieval system that provides information on traumatic deaths that are investigated by a coroner to registered users via a secure internet interface. Information recorded in the NCIS consists of: coronial administrative information; demographic information regarding the deceased; information regarding the fatal incident; and information regarding the fatal outcome. For some records, files are attached from different agencies and these can include a narrative description of the fatal incident provided by the police, an autopsy and toxicology report, and coronial findings. All injury-related deaths should be reportable to a coroner. Mortality data from the NCIS are only able to be identified based on the date of the notification of the death to the coroner, not on the actual date of death. ATV-related deaths in the NCIS can be identified using supplementary codes for mode of transport

(10.4 – ‘quad bike, ATV’), along with text searches of narrative event descriptions using keywords.

Limitations of the existing data collections

There are several significant limitations of all of the five data collections. It is difficult to accurately identify ATV incidents, with these incidents only being able to be identified through searches of text descriptions of event circumstances, such as in the incidents identified in WorkCover NSW data collections, or through identification as a sub-category of another classification, such as a sub-category of special all-terrain vehicles within the APDC.

There is a general lack of information recorded in the administrative data collections regarding the model and type of ATV, whether any roll over protective structures (ROPS), attachments or loads were affixed to the ATV or whether any objects were being towed by the ATV. Whether the injured person was the sole operator or a passenger on the ATV is difficult to ascertain in some data collections and information as to whether the individual was wearing either a helmet or a restraint is not often collected. Where text descriptions were provided, the exact circumstances of the incident in most cases is difficult to identify. For example, a common phrase was ‘fell off ATV’, but the reason why the person fell off were not often recorded.

The ATV-related injuries in the WorkCover NSW workers’ compensation claims and Inspector’s incident reports are identified either through the TOOCS classification framework or by searching incident text descriptions for ATV incidents. It is possible that some ATV incidents will not be identified if text descriptions are missing or if there were spelling errors. It might be expected that for the WorkCover NSW Inspector’s incident reports, there would be more of an opportunity to obtain detailed information regarding the incident, especially in terms of the type and model of ATV, any loads being carried or attachments to the ATV or use of personal protective equipment, however much of this information remains missing. For the workers’ compensation claims data, there is also known under-enumeration of work-related injuries in workers’ compensation records, with workers who are self-employed, who are contractors, who are without dependents, or young workers known to not always make claims [ix].

Within the hospitalisation data recorded in the APDC, it is possible that there is better identification and/or recording over time of the four-wheeled ATV-related injury hospitalisations as enhancements were made to the ICD-10-AM classification framework in 2003-04 to identify the number of wheels on the all-terrain vehicle. While there is an activity

performed at time of incident classification of 'riding an all-terrain vehicle' within ICD-10-AM (i.e. ICD-10-AM: U65.0), the data quality of activity classifications in the APDC are known to be poor.

For the emergency department presentations reported in the NREDSS, it is possible that some ATV injuries will not be identified if trauma nurse descriptions were missing, relevant information was absent or there was orthographic variation resulting from spelling errors or use of abbreviations.

Lastly, there is a general lack of exposure data available in order to estimate the risk of injury for most injury types. This is also true for risk of injury following ATV use. Estimates are available for the number of ATVs sold in Australia, but there is no information available on the number of individuals who use ATVs or for the number of hours these individuals use an ATV, with this information needed in order to calculate person-risk or person-time risk, respectively.

The lack of this data has made it difficult to identify several key factors involved in ATV incidents, and most importantly has considerably hindered countermeasure development:

1. Lack of specific ATV model details which give the manufacturer, model year, exact model type and designation and engine size, precludes any trend or risk analysis by model make and characteristics;
2. Lack of specific details on loads being carried, front or back or both, the type of load (e.g spray tanks), manufacturer details, etc.
3. Lack of suitable description category of 'Activity being undertaken" at the time of the incident, including the terrain, is vital to understanding what may have been contributing factor to the incident, and the circumstances.
4. Lack of suitable description detail of "What went Wrong" and how the person was injured. For example, ATV hit depression and rolled, with driver ejected and the ATV rolled on top of driver pinning him underneath. Driver was asphyxiated." Etc.

Vehicle standards requirements for non-registered motorised vehicles, including vehicle design, engine capacity, mass and speed controls;

There are no Australian Standards that govern the design of ATVs. There is a US ANSI/SVIA 1 – 2010 American National Standard for Four Wheel All-Terrain Vehicles.

ANSI stands for the American National Standards Institute, Inc. and SVIA stands for the Specialty Vehicle Institute of America being an organisation essentially funded by manufactures much like the FCAI in Australia. There is also a European Standard EN 15997:2012 All terrain vehicles (ATVs - Quads) - Safety requirements and test methods which appears to be mandatory for all European countries. Both the US and European standard includes the same rearward pitch stability requirement only. There are no requirements for lateral roll or forward pitch stability. Nor are there any requirements in terms of handling or rollover propensity.

Currently there exists a decade long 'impasse' between manufacturers and end users of ATVs in terms of advancing vehicle safety technology. Some of the historical background how this evolved is discussed first.

Prof. Grzebieta and A/Prof. Rechnitzer were involved in a 2003 study into ATV safety and potential countermeasures at the request of the Victorian WorkCover Authority and the State Coroner [x, xi, xii]. The 2003 study was to provide a review of previous research relating to ATV fatalities and serious injuries and to examine the feasibility of fitting effective occupant protection systems, particularly regarding rollover.

The main findings from the 2003 MUARC study were:

- 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. Most serious incidents occur in agricultural settings.
- Quad-Bikes although based on motorcycle structures with two extra wheels added, have significant differences in handling, usage and collision modes. Despite these major differences, Quad-Bike safety philosophy retains and promotes, quite inappropriately, a motorcycle based and rider-centred perspective on safety, rather than a vehicle one. That is, Quad-Bike safety is considered to depend on rider separation from the vehicle and the addition of protective clothing and helmet. Simply put, such safety philosophies are ill conceived and dangerous for ATV riders. They do not offer any protection in the most common modes of injury with ATVs – rollovers, nor collisions.
- The design of ATVs in terms of their short wheel base, relatively narrow track and high centre of gravity positions, and lack of a differential, result in adverse handling characteristics, which are intended to be compensated by active-riding techniques.

Such techniques require shift in position of the rider's body to increase stability during manoeuvring. Stability analyses of the benefits of active riding show these to have quite limited benefit (about 20% or less), and overall would appear to be overrated as a means of enhancing the control of ATVs.

- Virtually all of the previous international research on fitting Rollover Protective Systems on ATVs to date has been predicated on having an unrestrained (or ineffectively restrained) rider so as to maintain active riding. This has led to Rollover Protective Structure designs with very poor effectiveness and in many cases designs that could well increase severe injury risk. Similarly, the Rollover Protective Structure designs suggested through the New Zealand (NZ) ROPS guide and those of United Kingdom Health and Safety Executive (UK HSE) are ill conceived, totally inadequate, indeed dangerous, as they provide inadequate survival space and do not require proper restraint systems.
- To ascertain the benefits and feasibility of fitting an effective Rollover Protective System, three crash scenarios were modelled, with and without the Rollover Protective System. The first scenario was an ATV travelling at 7km/h across a 30-degree slope in which the ATV rolls due to hitting a rock. The second scenario involved the ATV travelling at 30km/h across a 30-degree slope and rolling due to hitting a rock. The third scenario was the same as the second, but with the ATV travelling at 20km/h. In the case of the ATV without the Rollover Protective System. In the first scenario, the ATV rolled onto the rider, and in the second and third scenarios the rider was ejected striking the ground resulting in severe injury levels (fatal in the 2nd scenario). In the three scenarios where the ATV was fitted with the Rollover Protective System, the occupant received low injury levels.
- It is possible to design a practical rollover protection system for an ATV that will protect a rider against serious injury in a rollover, and other collision modes. Such a system requires a lightweight but high strength structure that protects the occupant survival space, together with a high backed seat with side bolsters, and seatbelt system to effectively restrain the occupant within the protected zone.
- The provision of Rollover Protective Systems on currently designed ATVs will result in reduced stability. To regain the original stability ratings, such ATVs would require either increased track width or lowering of centre of gravity height.

The MUARC report proposed a Rollover Protective System (ROPS) for ATVs. This was based on fundamental crashworthiness principles on what would be required ideally for effective rider protection both in a rollover and in collisions.

From this perspective, the deficiencies of other ROPS systems such as the rear single post or similar (as in NZ) were considered by A/Prof. Rechnitzer and Prof. Grzebieta at the time as quite deficient, and even potentially dangerous.

While such a perspective may have appeared justified at the time, in hindsight, a more incremental approach based on 'harm minimisation' now appears to be pragmatically more appropriate. The 'all or nothing' approach does not reduce injuries in the interim. For example, 2-post ROPS were encouraged to be retrofitted to older tractors in Victoria without seatbelts being mandated also - despite the knowledge that a risk of ejection from the tractor without seatbelts was still possible. Overall, this would be regarded as an effective pragmatic safety outcome for older tractors [xiii].

On the other hand the MUARC ROPS (and indeed any ROPS) was also strongly opposed by the ATV industry, and regarded by them as being more injurious than not having such a system. Such a claim was based on computer simulations by Zellner et al, and strongly questioned by the authors and others [xiv, xv, xvi]. The industry still opposes ROPS and CPDs (Crush Protection Devices) of all types claiming these do more harm than good [xvii, xviii].

While current prevention strategies continue to focus on lower order risk controls such as rider training and administrative controls, Prof. Grzebieta and A/Prof. Rechnitzer consider that the very successful passenger vehicle Australian New Car Assessment Program (ANCAP) type test and rating program could also be applied to overcome the 'impasse' and thus improve quad-bike safety.

The consumer stars on cars rating NCAP program has been successfully adopted in many regions including Europe, Australia, Japan and Asia, for example.

No one involved in transport safety can be in any doubt of the dramatic improvements in vehicle safety and crashworthiness, from the high road toll decades of the 1960's and 1970's to the much lower tolls in the developed world in the 1990's through to the current decade. Many vehicles now have multiple airbags, greatly improved crashworthy structures and handling assistance (ESC, pre-brake, etc.).

Notably, however, through this time the auto industry, in many cases (with well-known notable exceptions, of course) seemingly and often actively resisted development and implementation of many safety technologies which are now not only standard but ubiquitous

(e.g. airbags). Yet, today the auto industry can proudly boast of its great technological and safety advances, and the great benefits in terms of reduced community trauma.

Thus advances in safety were not inhibited by lack of engineering know how, but rather by lack of 'will' or incentive. Incentives for the auto industry have come in many forms, e.g. regulations (mandatory national vehicle safety standards), comparative consumer testing (NCAP), market competition, and perhaps even product liability litigation.

Of particular significance was the requirement for vehicles to meet minimum crashworthiness 'performance' standards based on set injury criteria, such as the US Federal Motor Vehicle Safety Standards (FMVSS) and in turn the Australian Design Rules (ADRs) frontal impact, offset frontal impact and side impact crash tests.

Handling improvements such as ABS and ESC (and all types of other driver assist systems) complement the improved vehicle crashworthiness through crash prevention measures.

And of course measures relating to improved driver action (drink driving); speed enforcement and road design all contributed significantly, and form part of the safe system approach to road safety [xix].

This parallel in advancement of Australian road vehicle safety via the ANCAP program leads to consideration of the current status of ATV safety and the decade long apparent 'impasse' through a similar program. The NSW WorkCover Quad Bike Performance Project mentioned earlier aims to provide farmers with a similar rating system to consider when purchasing either a Quad Bike or Side by Side vehicle. The testing program is being undertaken at the Crashlab test facility in Sydney, Australia.

The main project stages are:

1. Selection and purchase of 15 new representative Quad Bikes and SSV (Side by Side Vehicles) as shown in Figures 5 to 9;
2. Biomechanics analysis: further detailed identification of injury mechanisms related to rollover, especially crush and asphyxiation; and development of related crashworthiness test methods;
3. Series of static stability tests for lateral rollover and forward and rearward pitch, based on tilt table tests, with and without rider (using a Hybrid III Anthropomorphic Crash Test Dummy: ATD); and with typical fitment and combinations of accessory loads on the front and rear. Effect of a selected sample of CPD on stability will also be tested [see Figure 2];

4. Series of dynamic handling tests for lateral rollover propensity and forward and rearward pitch propensity with a rider and with typical fitment and combinations of accessory loads on the front and rear.
5. Series of crashworthiness tests related to lateral rollover and front and rear pitch, to determine serious injury risk with and without CPDs;
6. Establishment of stability ratings, dynamic handling ratings and crashworthiness ratings for the selected Quad Bike and SSV models;
7. Development of an NCAP type testing and rating system New Quad Assessment Program (NQDAP) for rollover stability, dynamic handling and rollover crashworthiness.

Figure 2 Quad Bike with CPD being tested for lateral roll stability

The vehicles selected for testing include eight Quad Bikes typically used in the work place, particularly on farms, three sports/ recreational type Quads, and four side by side utility style off-road vehicles used in the workplace/farms. The three sports/recreational Quads were added to the project and funded by the Australian Competition and Consumer Commission (ACCC). An additional two more vehicles have recently been added to the test program, namely the Tomcar vehicle and a six by six (6 x 6) straddle vehicle used by the Armed Services and manufactured by Polaris. The Tomcar vehicle boasts exceptional stability and high rollover stability characteristics.

In addition to the multi-disciplinary research team undertaking the project, the project is also supported by a highly experienced Project Reference Group, which includes a worldwide range of experts in ATV vehicle safety issues. The Reference Group includes ATV industry representatives, farming groups, safety regulators, university researchers, and safety consultants.

The outcome of the Project is to provide a clear 'way ahead' to improve the safety of Quad Bikes and Side by Side Vehicle types used in the workplace/farm (and recreationally) by providing consumers with a NCAP style performance based safety rating system to help identify appropriate vehicles for their use. Such a rating system is intended to help provide incentives to manufacturers and consumers to drive competition for improved safety for such vehicles, in a similar way to what has been achieved for automobile safety.

By focusing on a performance based system, rather than by prescription (e.g. prescribed fitment of CPDs), leaves open a wider range of vehicle design enhancements in relation to crash prevention (handling improvements, electronic controls, etc.) and crashworthiness (rider/ occupant protection) in a crash.

An additional further intended outcome of the NSW WorkCover Quad Bike Performance Project is the development standards for improved handling and reduced risk of rollover through performance requirements for lateral stability, handling with reduced rollover propensity and lateral, front and rear pitch crashworthiness.

The extent and effectiveness of education and the necessity for skills and competency training for users of non-registered motorised vehicles, particularly in relation to safe use

Most of the preventive activity related to ATV deaths and injuries has taken place within the agricultural setting, given that a large proportion of ATV related deaths and injuries occur in that setting. Farmsafe Australia takes a lead role in defining the nature and size of the farm injury problem, setting agreed goals and targets, and developing an agreed strategy for achievement of these targets. Quad Bike related injury is included in Farmsafe Australia's Goals, Targets and Strategy.

More recent public awareness of the ATV related fatalities and injuries and demands for safer workplace and recreational environments has seen the various state WorkCover Authorities, Safe Work Australia and the ACCC becoming increasingly more involved.

Different strategies to reduce the number of casualties are being considered. These include: Administrative controls such as ATV registration, rider training and licencing, minimum age restriction to 16 year old and no passengers for Quad Bikes; Personal protection such as helmets, gloves, and body armour; and Vehicle rollover safety such as fitment of Crush Protection Devices.

In Australia preventative strategies from industry have primarily focussed on provision of information and on training programs. While the fitment of rollover protection structures such as CPDs has been recommended by Farmsafe, they are opposed by the majority of manufactures as detailed earlier. On the other hand, attempts at providing education and training have not really met with much success.

In the USA, a ten year preventative program beginning in April 1988 included the withdrawal of 3 wheel ATVs from the market, a national ‘free’ training program for ATV users for which a rebate was offered, an $8.5 million dollar public awareness campaign, improved information to purchasers and age recommendations to prevent young children from using wrong sized ATVs. Despite these efforts some 89% of riders had not undergone training programs, by the ninth year of the program. This is despite the offer of a $50 rebate on the vehicle purchase, a $100 US Savings Bond, or a merchandise voucher worth at least $50. The most common reason for not taking the training was that the respondent view that they already knew how to ride. Other reasons included inconvenient time or location, or that a friend or relative provided the training. The removal of three wheel ATVs resulted in a decrease in deaths associated with these types of ATVs. However, the rates for deaths associated with four wheel ATVs was only marginally lower at the end of the 10 year program period.

The United States example confirms one of the general principles of injury prevention: that removal or modification of a hazard will usually be more effective than encouraging protective behaviours that need to be repeated on each occasion of exposure to the hazard.

Quad Bikes (Figure 1a) are based on motorcycle structure with two extra wheels added and the rider straddles the sea much like a motorcycle (Figure 2). This is in contrast to Side by Side vehicles (Figure 1b) where the driver and passenger can sit as in a car and where a roll cage, seat belts and side doors are provided to protect the occupant in the event of a collision or rollover. Quad Bikes are considered by the manufacturers and industry as 4-wheel motorcycles. As such Quad Bikes maintain the philosophical and 'safety' culture associated with motorcycles and not that typically associated with 4 wheel vehicles.

As with nearly all motorcycles, Quad Bikes have a similar lack of focus or provision for occupant protection in a crash. Because motorcycle design has traditionally provided very little in the way of occupant protection, active safety strategies relying on rider behaviour have been promoted to mitigate serious injury outcomes.

The extrapolation of this motorcycle based 'safety' philosophy to Quad Bikes is fraught with difficulties. Quad Bikes have quite different handling characteristics to motorcycles and they are used in different environments and by a different cross-section of users. It is pertinent to note that Quad Bikes were originally designed for recreational use, but because of their apparent versatility have been adopted and 'made to fit' for farm use. Thus with farm use additional items, such as spray units, are often carried on the front or rear or both. A further difference is noted for the injury mechanism, which for Quad Bikes is mainly related to rollover, whereas no such mechanism exists for motorcycles.

In considering this background to Quad Bike design and usage, it becomes apparent that the fundamental limitations of Quad Bike handling characteristics are intended to be overcome by 'active riding'. Active riding essentially relies on the weight shift of the occupant to increase rollover resistance, together with simultaneous throttle control for turning manoeuvres. Interestingly the required weight shift is to opposite sides for lower level turns versus high 'g' turns.

Whereas the application of active riding may have had some credibility (albeit limited) for Quad Bike recreational use, it would appear to be misconceived, for the following reasons, in regard to Quad Bike use on the farm:

- Active riding would appear to offer perhaps a 20% increase in rollover stability. For lighter weight riders this decreases to perhaps about 8%.
- Quad Bikes can have different rollover stability for the left side and right side because of an offset centre of gravity position, which for the same manoeuvre can in rolling over in one direction, but not rolling over in the other. Loads carried by the Quad Bike, particularly spray tanks, can also influence the positioning of the vehicle centre of gravity adversely.
- Active riding depends on the skill and fitness of the rider which can vary greatly amongst the different classes of users. In particular older/tired farmers may not possess the capacity nor fitness to actively ride, and more so towards the end of a hard day’s work.

- The effectiveness of active riding decreases significantly as the weight of the Quad Bike increases and/or when they are carrying items such as sprayers, other equipment or towing a small trailer.
- Riders can be lulled into a false sense of confidence by the notion of active riding, in that they may think they have more influence and control of the Quad Bike's stability than they actually have.
- Similarly riders can be lulled into a false sense of confidence by the notion that a four wheel vehicle is more stable than a motor bike, thus attempting to ride the vehicle similar to how a car can be driven.
- Active riding cannot help in the various circumstances which can result in destabilising a Quad Bike such as unexpectedly hitting a mound or depression in the ground.
- The notion that the rider has some effective control of his trajectory if ejected from a Quad Bike is quite spurious. The promotion by the industry that a rider can mitigate his injury risk by the way he/she falls, jumps from the vehicle, or puts out their arms is quite fallacious for a number of situations. In any case, in most situations where loss of control occurs, the time interval available would be too short particularly for tired and/or older riders to react in terms of trying to mitigate the resultant impact severity.

It is worth noting that the TARS Quad Bike Performance Project research team took up an offer by the Federal Chamber of Automotive Industry (FCAI) and Honda Australia Rider Training to complete a one day course at the HART St Ives Rider Training Centre. Comments from participants noted that:

- Novice riders (particularly those who have ridden motorcycles) can be lulled into a false sense of confidence that riding a Quad Bike is similar to riding a motorcycle albeit with the extra two wheels it appears safer because Quad Bike remains upright when stationary. The wearing of a motorcycle helmet during training further made the training experience seem as if it was not dissimilar to riding a motor-bike albeit a safer experience.
- However it is also apparent, that it is essential riders be trained first how to ride a Quad Bike so that they are provided with the extensive educational information

concerning the hazards of riding a Quad Bike and trained how they should be ridden and thus avoid common hazards and risks associated with such vehicles.

- There was a sense by most of the riders undergoing the training course that the line between being in full control while driving a Quad Bike and suddenly finding oneself in a circumstances which can result in destabilising a Quad Bike, was very fine if not too fine. It was clear to all participants that Quad Bikes would present a high risk of injury to anyone under the age of 16 driving them.
- An interesting and significant conclusion was reached by the riders post training that if a potential new owner of a Quad Bikes (e.g. a farmer) did undergo training prior to purchase of a Quad Bike, they might decide not to purchase this vehicle type because of a better appreciation of the injury risk when operating such vehicles – and the recognition that alternative vehicles such as Side x Sides vehicles may be a much better choice as a farm work vehicle than ATVs.
- Riders noted there were clear differences in terms of handling between the heavier and lighter Quad Bikes, those Quad Bikes with different suspension systems, i.e. locked differential versus independent and independent suspension. It was noted that research should be carried out to assess the difference between the various suspension systems in terms of handling and rollover propensity.
- There was an agreement that Quad Bikes should be regulated, i.e.
    - Quad Bikes should be registered. This would elevate their awareness in terms of injury risk potential and provide an opportunity for insurance cover for injuries that may occur in off-road incidents;
    - All riders should be licenced where they are required to undergo a training course;
    - If registration and licencing were not possible then new Quad Bike the owners of the vehicle should be required to undergo training prior to taking possession of the vehicle and that the cost of training be included in the purchase price of the vehicle;
    - No passengers (pillions) be allowed on a Quad Bike;
    - No-one under the age of 16 be allowed to drive or ride on an adult size Quad Bike;

- That a helmet is developed specifically for Quad Bike and Side by Side vehicles that provided ventilation and sun protection while providing appropriate head protection.

Initiatives taken by local Councils and other jurisdictions to certify, register and regulate the use of currently non-registered motorised vehicles

Some comments have already been provided above regarding ATVs. The TARS research team would support the registration of both Quad-Bikes and Side by Side vehicles and the licencing of riders and mandatory training of drivers. However, while this administrative control could possibly reduce the number of deaths and serious injuries occurring as a result of the use of these vehicles, the effect would be much greater if there was a Safe System approach similar to what has been accepted for public roads and road safety [xx], i.e. safer people, safer roads and safer vehicles. As already stated removal or modification of a hazard will usually be more effective than any administrative control alone. For this reason the NSW WorkCover funded Quad Bike Performance project currently managed by TARS at UNSW to rate Quad-Bikes and Side by Side vehicles in terms of safety injury outcomes, will drive the technology and vehicle safety much like the ANCAP program has helped reduce road casualties.

Motorised Mobility Scooters

The current status of Motorised Mobility Scooters vehicles in road rules definitions and the extent of road safety problems related to their use

There is anecdotal evidence indicating a rapid increase in the use of Motorised Mobility Scooters (MMS) in Australia. However, their exact number is difficult to quantify as they are not subject to registration and licensing requirements. As the vast majority of these devices are imported, customs figures show that in 2008 alone 12,000 MMS were imported which is about 1.2% of the size of total motor vehicle sales for the same year [xxi].

The Australian Road Rules consider MMS, the same as motorised wheelchairs, as a pedestrian and the rules that apply are the same as it applies to pedestrians. These rules only apply provided MMS cannot travel at a speed greater than 10 km/h (on level ground), has an unladen weight not exceeding 110 kg, and can only travel on the road where a footpath is not available, is being repaired or is unsafe due to damage. [xxii, xxiii] However, the way these rules apply in reality remains ambiguous due to the lack of reliable information on how MMS are used within the transport system as well as the nature of MMS models available in the market.

While there is a general lack of information on the exact number of MMS used, a recent national survey estimated that 231,000 Australians use MMS, with about half of users aged 60 years and over [xxiv]. The survey found that reduced walking/physical mobility was the key trigger for taking up use of a MMS. While it has been suggested that MMS are used as an alternative to the motor vehicle, as arguably the health and cognitive requirements for using a motorised scooter are less than for driving a car [xxv], the national survey of MMS use show that only 13% of respondents indicated that Loss of drivers' license prompted them to take up use of MMS. The same survey also showed that many MMS s users see their scooter as a lifeline for independent living with 90% of those aged 60 years and over indicating that MMS use improved their ability to maintain independence by allowing better access to services, social activities and interaction with friends and family. These findings are supported by a number of other studies that show that the use of MMS improve quality of life by enhancing sense of freedom, independence and self-esteem and facilitating social interaction [xxvi, xxvii, xxviii].

Despite these benefits, there is mounting community concern over their safety following media reports and a couple of research publications on the growing problem of

MMS injuries. Overall, there is a paucity of reliable data on the magnitude of this problem. The only comprehensive study in Australia showed that, over a two year period (July 2006 to June 2008), 442 people aged 60 years and over were hospitalised as a result of a MMS-related injury costing the health system an average of $5,665 per hospitalisation [xxix]. However, the total number of MMS hospitalisations is likely to be much greater due to data and coding issues, including the fact that identified cases are restricted to fall injuries and excludes motor vehicle collisions and other transport related injuries where no fall is involved. In the case of motor vehicle collisions, MMS are coded as pedestrians and the true prevalence of these cases remains unknown.

An Analysis of the injury severity related to the Victorian motorised mobility scooter hospitalisations identified in the same study suggests that a significant proportion of the resulting injuries will have a serious effect on the patient in terms of persisting health problems and follow-up health care. Overall, 36% of motorised mobility scooter hospitalisations were categorised as 'serious'. This is a much higher rate of serious hospitalisations than found for all unintentional injury causes combined (16%) and also higher than for all types of injury in the 60 years and older age group (30%).

Based on the National Coroners Information System, the study also identified 62 fatalities related to MMS in Australia over the last decade with half of these deaths resulting from collisions with a motor vehicle, mainly a car. Most case narratives simply stated that the scooter and motor vehicle collided with no further details of the circumstances. When information was recorded, some of these crashes occurred while crossing the road, entering an intersection but also travelling along the road, an important issue for regulators. The same study also showed that the frequency of ED presentations as a result of MMS-related injury in Victoria increased significantly by 255% over the decade between 2000 and 2009, reflecting the reported rise in the use of MMMS among older people in the community. This trend is likely to continue as the population ages and more impetus is placed on maintaining the mobility and independence of older people.

The actual rate of morbidity and mortality (number of serious injuries or deaths per mobility scooter using population) remains unknown due to lack of information on the number of MMS in the community. More importantly, there is very little information about the circumstances and risk factors of MMS incidents due the limitations of available sources of data, such as hospital records and police crash data, and a lack of high quality research studies in this area. A South Australian study, where participants were asked to describe their most recent MMS accident, found that most reported accidents were related to the loss of

control of the vehicle, particularly as a result of unintentional acceleration. However, the small sample size of the study limits its generasibility to the rest of the population of MMS users [xxx].

The adequacy of data collection for injury and fatality rates arising from the use of Motorised Mobility Scooters

NSW Admitted Patient Data Collection

Currently in Australia, only hospitalised injuries resulting from a fall from a scooter are able to be identified through the external cause code: "fall involving other and unspecified pedestrian conveyance – fall involving powered scooter" (i.e. W02.9). Identified cases, using this code, are restricted to fall injuries and excludes motor vehicle collisions and other transport related injuries where no fall is involved [xxxi]. In the case of motor vehicle collisions MMS are coded as pedestrians and it is therefore difficult to know their exact number.

Recent 2013 changes to ICD 10 codes [xxxii] have sought to readdress some these issues by adding external cause codes that include some road crashes involving MMS. These codes are: V00.83: "Accident with motorized mobility scooter"; V00.831: "Fall from motorized mobility scooter"; V00.832: "Motorized mobility scooter colliding with stationary object" and V00.838: "Other accident with motorized mobility scooter"

National Coronial Information System (NCIS)

MSS-related deaths in the NCIS can be identified using supplementary codes for land vehicle (other land vehicle, means of land transport –mobility scooter, gopher) along with text searches of narrative event descriptions using keywords (i.e. mobility scooter, electric gopher, electric mobility scooter, electric scooter, gopher, medical scooter).

Vehicle standards requirements for Motorised Mobility Scooters including vehicle design, engine capacity, mass and speed controls

Currently, while there are safety standards for electric wheelchairs that are claimed to apply to MMS, Australia has no safety standards for mobility scooters. The standards that are claimed to apply to mobility scooters are provided in Table 1.

However, motorised scooters and electric wheelchairs differ markedly in structure and technical design requiring the development of separate standards. The lack of the availability of specific standards is likely to compromise the safety of MMS and is partly hindered by the lack of rigorous studies on the design and safety features of various models of mobility scooters available in the market. There is also a need for concerted efforts from interested organisations and members of the community to champion the process of the development of these standards.

Standard	Name of Standard	What it deals with
AS 2142	Reflectors for pedal bicycles	Acceptable types of reflectors for visibility
AS 3696	Wheelchairs	3696.1 Static stability 3696.2 Dynamic stability 3696.3 Efficiency of brakes 3696.4 Energy consumption 3696.5 Overall dimensions, mass & turning space 3696.6 maximum speed, acceleration & retardation 3696.8 Static, impact & fatigue tests 3696.9 Climatic tests 3696.10 Obstacle climbing ability 3696.14 Power and controls
AS3744.1	Ignitability of upholstery	Smouldering cigarette
ISO 7176-7	Wheelchairs – seating dimensions	Size of & accessibility to seat

Table 1: Various standards that are claimed to apply to mobility scooters

Conclusions and Recommendations

ATVs

It is difficult to accurately identify ATV incidents in available administrative data collections, with these incidents only being able to be identified through searches of text descriptions of event circumstances, such as in the incidents identified in WorkCover, NSW data collections, or through identification as a sub-category of another classification, such as a sub-category of special all-terrain vehicles in the hospital data.

There is a general lack of information recorded in the administrative data collections regarding the circumstances of ATV related crashes. This include whether the injured person was the sole operator or a passenger on the ATV, whether the individual was wearing either a helmet or a restraint, model and type of ATV, whether any roll over protective structures (ROPS), attachments or loads were affixed to the ATV or whether any objects were being towed by the ATV. Changes to data coding are needed in order to identify cases and circumstances of ATV related crashes in administrative datasets.

There is a general lack of exposure data available in order to estimate the risk of injury associated with ATV use. While estimates are available for the number of ATVs sold in Australia, but there is no information available on the number of individuals who use ATVs or for the number of hours these individuals use an ATV. Population surveys are needed to get access to this important information.

There is no Australian Standard for the design and operation of ATVs. An Australian Standard should be developed which includes requirements for lateral roll, rearward pitch and forward pitch stability. That Standard should also include requirements in terms of handling or rollover propensity.

While administrative control could possibly reduce the number of deaths and serious injuries occurring as a result of the use of ATVs, the removal or modification of a hazard will usually be more effective than any administrative control alone. Continued support for safety rating ATVs (Stars on Quads and SSVs) similar to the ANCAP system should be provided by state and federal governments. Consumers will then be able to consider which ATV provides the best safety risk outcomes in terms of purchase decisions. This will in turn cause manufacturers to consider technology design changes to their vehicles and compete with each other to secure market share.

The majority of Quad-Bike sales are to people who do not undergo any training. The TARS Quad Bike Research Project team support the introduction of mandatory training with the purchase of each new Quad Bike. The cost of the training should be included into the purchase price of the Quad Bike. Moreover the TARS research team would be supportive of registration of all ATVs, licencing of all drivers, restricting drivers to 16 and over, and wearing of helmets be mandatory.

There needs to be increased promotion of alternative vehicles such as Side x Sides vehicles which may be a better choice as a farm work vehicle than ATVs.

MMS

While the Australian Road Rules attempt to provide a common approach to the use of motorised scooters within each Australian state and territory by classifying them as pedestrians, ambiguity remain about their application in the real world. For instance, there is anecdotal evidence that newer and more powerful scooters are entering the market and are being used on paths as well as on the roads. Studies that examine scooters usage including patterns of use within the transport system are needed to provide more reliable information in this area.

Data on injury related to use of MMS is very limited. Accident statistics involving MMS users are not available as they are classified mostly as pedestrians. Similar classification applies to other sources of data such hospital admissions when only falls from MMS can be identified while those involved in a transport accidents could not. As result, the burden and more importantly the circumstances leading to MMS crashes remain largely unknown limiting any future prevention efforts. There is a need for epidemiological studies (i.e. cohort studies) that will examine the circumstances leading to MMS crashes in order to inform strategies aimed at improving their safety.

There is also a need for better coding of MMS crashes in administrative datasets including Accident statistics and hospital data in order to improve the surveillance and monitoring of this type of incidents.

The lack of specific standards for MMS is likely to compromise the safe use of these vehicles. The current situation where safety standards for electric wheelchairs are claimed to apply to mobility scooters is problematic as motorised scooters and electric wheelchairs differ markedly in structure and technical design. There is an urgent need for rigorous studies that examine the design and safety features of various models of mobility scooters available in the market. Such studies will inform the development of specific standards for MMS in Australia.

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