QUEENSLAND COURTS

OFFICE OF THE STATE CORONER

FINDINGS OF INQUEST

CITATION:	**Inquest into nine (9) deaths caused by Quad Bike accidents**
TITLE OF COURT:	Coroners Court
JURISDICTION:	Brisbane
FILE NO(s):	Various
DELIVERED ON:	3 August 2015
DELIVERED AT:	Brisbane
HEARING DATE(s):	20 May 2014, 6-8 August 2014, 11-12 August 2014, 19 September 2014, 26 September 2014 (findings phase 1), 20-21 November 2014, 24-26 November 2014, 13-17 April 2015.
FINDINGS OF:	Mr John Lock, Deputy State Coroner
CATCHWORDS:	CORONERS: Inquest, quad bike accident, rollover, operator protective systems, roll over protection systems, crush protection devices, crush protection vests, personal locator beacons, training, certification and licences, helmets, children, star rating system, police investigations.

REPRESENTATION:

Counsel Assisting:	Mr Peter De Waard, Office of the State Coroner
Federal Chamber of Automotive Industries (FCAI):	Mr Liam Dollar (instructed by Norton Rose Fullbright Australia)

Workplace Health & Safety Queensland:	Mr Kevin Parrott (Crown Law) (instructed by Office of Fair and Safe Work Queensland)
Polaris Industries Australia and New Zealand	Mr Peter Roney QC, (instructed by Baker & McKenzie)
Mort & Co Pty Ltd and R B Hughes (Wentworth Cattle Co)	Mr Alan Girle of Sparke Helmore Lawyers

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Introduction

1. Approximately 200 deaths involving quad bikes have occurred in the past decade in Australia and New Zealand. Most have occurred in a rural setting and quad bike accidents are the leading cause of death on farms in Queensland.

2. It is uncontroversial to say that a number of statistical sources confirm that the majority of deaths occurred in two age groups being those between 10 – 19 and for those over the age of 50.

3. Whatever may be said about the utility of quad bikes, they have become essential equipment on many farms. That being said, the evidence gathered during this multiple inquest raises many issues about the safety of quad bikes, including the importance of active riding; good mechanical maintenance; use of correct tyre pressure; use of helmets; disallowing children to ride adult sized quad bikes; understanding the limitations of the vehicle; and that tragic incidents can occur in quite benign conditions. The cases also emphasise the importance of riders making appropriate decisions.

4. There has been very considerable research, studies, reports and investigations carried out by various persons and organisations over some decades considering how to reduce the number of quad bike related accidents. Although there is considerable agreement in relation to a number of the issues, there has been robust disagreement between the manufacturers and their research on the one hand, and safety advocates and their research on the other, on some of the more contentious issues, including engineering and design solutions to reduce roll overs and roll over protection. To say there has been an impasse to moving forward on these issues is an understatement.

5. The US Consumer Product Safety Commission (CPSC) had been reviewing deaths and injuries associated with quad bikes since the 1980s. It issued an Advance Notice of Proposed Rule Making on all-terrain motor vehicles in October 2005 and followed up with a Notice of Proposed Rulemaking in 2006. With the introduction of a mandatory quad bike standard (largely formulated by the industry) in 2009, the CPSC has continued to monitor quad bike related deaths. Apart from public awareness programs, there has been little development in relation to engineering solutions. The CPSC's message in their public awareness campaigns is consistent with many of the recommendations considered uncontroversial in the course of this inquest, including not allowing children under 16 to ride an adult sized quad bike; disallowing passengers on single seat quad bikes; always wear a helmet and other protective gear; and undertaking a hands-on safety training course.

6. Manufacturers provide clear warnings about such issues in owner manuals and by way of warning stickers displayed on the vehicle itself. However, the consistent anecdotal evidence (confirmed in a number of the tragic cases considered in these inquests), is that these warnings are often ignored. Indeed the cases that were the subject of the first phase of this inquest involved examples where at least one or more of such warnings were ignored.

7. I have been monitoring developments in the debate about quad bike safety for a few years, to see if it was in some way advancing constructively.

8. I thought there may have been some movement forward to a resolution, when in December 2012 the Commonwealth Government, through the then Minister for Employment and Industrial Relations, issued a Discussion Paper on quad bike safety, particularly relating to engineering options to:

- change the current design of quad bikes to improve safety;
- improve protection for the rider in the event of a roll over;
- restrict the capacity for children to start and/or operate quad bikes; and
- restrict the capacity for passengers to be carried on quad bikes.

9. Regulatory controls were not being considered, as it was noted, that for over 20 years, the focus on quad bike safety in Australia has been on other approaches like training and education, awareness raising and helmet use, to address the high number of fatalities and serious injuries sustained by quad bike riders. The Discussion Paper noted the time had come to focus on design and engineering controls for improving quad bike safety.

10. The initiative was placed in the hands of Safe Work Australia, who was assisting the Minister in the review. In particular, it was noted by the Minister in a press release that Safe Work Australia would now work with State and Territory regulators to institute a plan on children under 16 years not operating a quad bike of full size in a workplace. The Minister also stated that quad bikes must have improved design so they are not prone to roll over, and some form of crush protection device is required to reduce the potential for death and injury from crush or asphyxiation when they do roll.

11. Earlier in 2012, it was also announced that a research project was to commence, which was to be conducted by the Transport and Road Safety Research Unit (TARS) at the University of New South Wales on behalf of WorkCover NSW and the Australian and New Zealand Heads of Workplace Safety Authorities. The report on this research was due for release in the latter part of 2014.

12. Notwithstanding the issues being considered by Safe Work Australia, TARS, and a number of other organisations and persons interested in agricultural safety; deaths were still occurring and with no resolution of many of the issues that were being continually aired in the public arena.

13. There have been other inquests held in Australia and New Zealand, which have considered some of these issues and I will refer to these shortly in my decision. The Deputy State Coroner in NSW is also holding an inquest considering quad bike deaths and safety issues. The Office of State Coroner for Queensland has provided her investigators with much of the material gathered in preparation for this inquest.

14. In 2014, I decided to hold an inquest examining the circumstances of the deaths of nine individuals and also to hear evidence concerning what recommendations should be made to help prevent deaths occurring in similar circumstances in future. I waited until the TARS report was able to be made available to me. I thank TARS and WorkCover NSW for so doing.

15. I did expect the task to be a complex one and I have not been disappointed.

16. For instance, even in respect to some of the uncontentious regulatory controls referred to above, and despite agreement by most witnesses for the need for greater regulatory control, it is not clear as to who should be responsible for taking leadership or management in implementing those controls. Hence, simplistic recommendations were unlikely to be heeded without consultation with a wide and varied group. This is what I hope has at least been achieved in the course of this inquest.

17. My focus during the inquest has been in relation to the use of quad bikes in a rural setting. Some of the deaths occurred in the context of agricultural activities and had a clear relationship with the farm as a workplace. Some of the deaths occurred on farms in the course of non-work related activities.

18. Quad bikes not only have utility in a work setting, they are also utilised in a recreational setting. I have not considered in any detail recreational use. One reason for this is that not many deaths are associated with recreational users who use the vehicles competitively or in deliberately higher risk situations. The reason for this is uncertain but I suspect such recreational users utilise greater personal protective equipment, are engaged in active riding, are aware of and anticipating potential difficulties, and are able to avoid the consequences.

19. In the end, if there are to be future developments leading to safer use of quad bikes, State and Federal Governments and agencies under their control or auspice are going to have to make regulatory changes and facilitate a way forward. There are inevitable resourcing implications. The manufacturers and safety advocates are also going to have to come on board in a greater sense of cooperation and collaboration than seems to have occurred in the past.

20. I should at this point offer my thanks and acknowledge the very extensive work conducted by Counsel Assisting, Mr Peter De Waard, in gathering together the information contained in the brief of evidence; in the wide consultation process he instituted; in conducting the inquest; managing to understand some fairly technical evidence, and producing detailed submissions. It was a mammoth task, largely undertaken alone. I should also acknowledge the exhaustive work conducted by Ms Debra Howarth from our investigation team in compiling the evidence in a usable form and overcoming and managing many challenges as the inquest proceeded.

21. As well as detailed submissions from Mr De Waard, I have also received detailed responses from the legal counsel representing the Federal Chamber of Automotive Industries (FCAI) and Polaris. They have suggested minor amendments to some of the recommendations and these suggestions have been helpful. They of course do not agree on everything submitted by Mr De Waard, and I did not expect them to.

22. I do not intend to include in my decision the level of detail contained in those submissions. I acknowledge I have utilised Mr De Waard's submissions with respect to many of the non-contentious factual issues and that has very much assisted me. I have made the submissions available to interested parties, including witnesses who appeared at the inquest and others who requested them, provided they met the sufficient interest criteria.

23. This inquest was broken up into two phases, over three weeks of hearings. Thirty four (34) witnesses in total provided oral evidence. An index to the Brief of Evidence for the second phase is attached to this finding.

First phase of the inquest – circumstances of each death

24. The first phase of the inquest was held over 6–12 August 2014, when the circumstances of the following nine quad bike related deaths were examined:

- A 40 year old man who died on 3 January 2014;
- A 9 year old boy who died on 3 January 2014;
- An 11 year old girl who died on 12 December 2013;
- An 11 year old boy who died on 15 September 2012;
- Mr Reginald Hasted Beauchamp, an 86 year old man, who died on 27 December 2013;
- Mr Guss Robert Haken, a 21 year-old man, who died on 12 October 2013;
- Ms Zoe Louise McInnes, a 28 year old woman, who died on 19 June 2013;
- Mr Gregory Peter Hoare, a 42 year old man, who died on 9 May 2013; and
- Mr Geoffrey Grahame Moore, a 51 year old man, who died between 6 – 7 March 2012.

25. Non-publication orders have been made in relation to the identities of the deceased persons who have not been named above.

26. Separate findings for each individual death were delivered on 26 August 2014. A copy of my findings can be found on the Office of the State Coroner's website.

Inquest issues for phase 2 - preventative measures

27. The second phase of the inquest was concerned about my functions under s.46 of the *Coroners Act 2003,* to comment on anything connected to the death that relates to ways to prevent deaths occurring in similar circumstances in future.

28. The scope of the recommendations to be considered in the second phase was settled at a pre-inquest conference held on 19 September 2014, as follows:

Training

1) Whether existing quad bike training can be improved, standardised and participation more effectively encouraged; and

2) Whether a mandatory licence or certification scheme should be introduced.

Helmets

1) Whether an Australian Standard should be introduced for quad bike specific helmets; and

2) Whether wearing a helmet when operating a quad bike should be mandatory.

Child safety

1) Whether children under 16 years should be prohibited from riding adult sized quad bikes as operators and passengers.

Passenger safety

1) Whether carriage of passengers on quad bikes designed for single operators only should be prohibited.

Operator protective systems

1) Whether the installation of a crush protection device or a roll over occupant protection system is an effective way to minimise deaths from quad bike roll-overs; and

2) If so, whether the installation of such devices and systems could be more effectively encouraged or mandated, where appropriate.

Quad bike safety design standards

1) Whether an Australian Design Rule or Australian Standard based on American National Standard (ANSI-1-2010) should be mandated for the manufacture, import and supply of quad bikes in Australia.

Increased consumer awareness

1) Whether the introduction of a star rating system (similar to the Australian New Car Assessment Program) would assist consumers to choose quad bikes that are fit for purpose and to further encourage safety innovation by industry.

Improving investigations and safety research for the future

1) Whether a standardised police investigation template for quad bike fatalities should be introduced; and

2) Whether police investigator training can be improved to cover specific issues arising in quad bike fatalities.

Consultation with stakeholders

29. During the coronial investigation Mr De Waard, consulted widely on my behalf, and obtained opinions and responses from 30 different agencies and organisations (stakeholders), as follows:

- the Federal Chamber of Automotive Industries (FCAI);
- Polaris Industries Australia and New Zealand (Polaris);
- Ag Tech Industries;
- QB Industries;
- Delta-V-Experts;
- Geoff McDonald and Associates Pty Ltd;
- Quad Safe Australia, Extreme Motorcycles, and Extreme Quad Adventures;
- Motor Cycling Australia Quad Commission;
- AgriFood Skills Australia;
- Australian Quad Distributors Association (AQDA);
- the Commonwealth office of Safe Work Australia (SWA);
- the Commonwealth office of the Australian Competition and Consumer Commission (ACCC);
- the Commonwealth Department of Infrastructure and Regional Development;
- Standards Australia Limited;
- National Coronial and Information Services (NCIS);
- the Queensland Office of Fair Trading (OFT);
- the Queensland Office of Fair and Safe Work Queensland now the Office of Industrial Relations [Workplace Health and Safety] (WHSQ);
- the former Queensland Commission for Children and Young People and Child Guardian;
- the Centre for Road Accident Research and Road Safety Queensland at Queensland University of Technology (CARRS – Q);
- the Queensland Department of Transport and Main Roads;
- the Queensland Police Service (QPS);

- Queensland Quad Riders Association (QQRA);
- Far North Quad Riders Club Inc;
- AgForce Queensland;
- the Queensland Farmers Federation (QFF);
- the Queensland Tourism Industry Council (QDIC);
- the University of New South Wales Transport and Road Safety Research 'Quad Bike Performance Project' team (TARS project team);
- New South Wales Workcover;
- the Australian Centre for Agricultural Health and Safety at the University of Sydney (AgHealth); and
- the Monash University Accident Research Centre at Monash University (MUARC).

Oral evidence

30. During the second phase of the inquest, the documentary evidence gathered was supplemented by oral evidence from 18 witnesses. A consultative, rather than an adversarial approach was endeavoured to be undertaken and I utilised the principles of concurrent evidence (also known as 'hot tubbing').

31. As noted in the submissions by the FCAI and some witnesses, including Professor Raphael Grzebieta, the environment was described as collaborative, rather than as adversarial as occurred in past inquests. On many issues, the experts agreed. However, on the more contentious issues of engineering of quad bikes and roll over protection it was evident there are still clear differences of opinion. The inquest has provided an opportunity for these issues to be aired and tested as best as can be in an inquest setting. Ultimately, without further collaboration and even compromise, engineering solutions will remain a vexed issue.

32. Oral evidence was heard from the following witnesses:

- Mr Cameron Cuthill, the FCAI's All Terrain Vehicle Manager;
- Dr Tony Lower, Director of AgHealth;
- Senior Sergeant Simon Lamerton, the Officer in Charge of QPS Forensic Crash Unit in Brisbane;
- Sergeant Nicole Fox, QPS Forensic Crash Unit Training Co-ordinator;
- Ms Donna Heelan, the WHSQ's Manager of Coronial Liaison & Investigation Support Services;

- Mr Colin Lawson: North Queensland Quad Bike Recreational Club representative; Director of Extreme Motorcycles; Director of Quadsafe Australia; and Director of Extreme Quad Adventures;

- Ms Georgie Sommerset, Vice President of AgForce Queensland;

- Dr Chris Van Ee, Biomedical and Mechanical Engineer from Design Research Engineering, USA;

- Dr Shane Richardson, Principal Forensic Engineer and Managing Director of Delta-V Experts;

- Mr Scott Taylor, Polaris Product Manager, USA;

- Mr David Robertson, Director of Quad Bar Industries;

- Dr Terrance Smith, Principal Scientist of Dynamic Research Inc. USA;

- Mr Geoff McDonald, Engineer and Director of Geoff McDonald & Associates Pty Ltd;

- Dr Robert Anderson, Mechanical Engineer from Hall Technical;

- Professor Raphael Grzebieta, Project Manager of the UNSW TARS Quad Bike Research Project;

- Mr (Jeffrey) Keith Simmons, Managing Director of KND Consulting Pty Ltd;

- Dr Graeme Fowler, Principal Engineer of Exponent, USA; and

- Mr John Zellner, Aeronautical Engineer, President and Technical Director of Dynamic Research Inc. USA.

Background

What is a quad bike?

33. A quad bike (also known as an 'ATV' – All Terrain Vehicle) is essentially a four-wheeled motorbike. It is a motorised vehicle designed to travel on four low-pressure tyres, having a seat designed to be straddled by the operator, and handlebars for steering control.

34. The term 'All Terrain Vehicle' has attracted criticism from two Coroners in Victoria and New Zealand who felt the term was misleading on the basis they were prone to roll over in difficult terrain. The industry maintains that the vehicles are able to be used on multiple terrains and distinguish 'terrain' to 'topography'. In this inquest, the term 'quad bike' has been adopted by me, conscious of both arguments and simply because the phrase is known better to the general public in Australia.

What is a side by side vehicle?

35. A side by side vehicle (SSV) (also known as a 'UTV' – Utility Task Vehicle or a 'ROV' – Recreational Off Highway Vehicle) is a two to six person vehicle based on a quad bike but with a side by side bucket seating arrangement, steering wheel, seat belts, and a roll over protection system. Many side by side vehicles also have a cargo box at the rear of the vehicle.

36. Quad bikes and SSVs are used for both recreational purposes, either privately or in tourism, and for agricultural purposes. In Australia and New Zealand, they are typically used in rural settings. They have become essential equipment on many farms. They are also utilised by search and rescue teams. In the US, quad bikes and SSVs are predominantly used in a recreational setting.

37. SSVs as compared to quad bikes are different vehicles but it is important to acknowledge that SSVs may very well be vehicles that should be considered by consumers and employers when 'fit for purpose' assessments are being made about equipment.

Roll over protection

38. Most standard quad bikes have no roll over protection system (ROPS). In broad terms, a ROPS is a cabin or roll bar structure on top of the quad bike, which incorporates a seatbelt to restrict movement outside the protective zone in the event of a roll over. Other possible protection mechanisms include Crush Protection Devices (CPD), which is a two bar or circular structure attached to the rear of the vehicle, and aims to provide a protective space in the event of a roll over, (but without a seat belt). The utility of either device has been the subject of considerable debate and disagreement.

The quad bike and side by side vehicle market in Australia

39. Quad bikes have been sold in Australia for the last 20 years. It has been estimated by the quad bike and SSV peak industry representative, the Federal Chamber of Automotive Industries (FCAI), that there are between 270,000 - 300,000 quad bikes and SSVs in use in Australia.

40. The USA makes up around 90% of the worldwide quad bike and SSV market. The Australian market is estimated by the FCAI to comprise about 3% of the world's market.

41. In Australia, FCAI members (and Polaris) sell in total around 20,000 quad bikes and SSVs each year. The Australian Quad Distributors Association (AQDA) is an organisation of members who sell Chinese manufactured quad bikes and SSVs in Australia. They estimate that their sales make up about 10 – 15% of the market (ie. 2,000 – 3,000 quad bikes and SSVs each year).

42. For sales volume reporting purposes, the FCAI splits quad bikes and SSVs into three broad category types, based loosely on (the manufacturer's) intended use. The three main categories are:

    - Agricultural / Utility;

- Sport; and
- Fun (ie. youth).

43. 76% of Australian sales are estimated by the FCAI to be in the Agricultural / Utility category. The Sport category accounts for 7% and the Fun (youth) category accounts for 17%.

44. The FCAI estimates that quad bikes make up roughly 75% of total sales in Australia, and SSVs make up 25%. The proportion of SSVs being purchased compared to quad bikes is increasing.

45. It is estimated, based on the FCAI annual sales data, that about one third of Australian quad bike and SSV sales occur in Queensland.

Quad bike related deaths in Australia

46. It is estimated that there have been between 160 – 200 quad bike related deaths in Australia over the past 11 years since records have been kept in the National Coronial Information System database. On average, 15 – 20 people die per year in Australia on quad bikes, and there is no sign of this trend slowing down.

47. The proportion of quad bike fatalities in Australia is less, but close to, the passenger vehicle road toll in Australia, per 10,000 vehicles.

48. Queenslanders make up about a quarter of the national quad bike related death toll, and with New South Wales, they have the highest rate of quad bike deaths in Australia.

Quad bike related injuries in Australia

49. Information regarding non-fatal quad bike related injuries in Australia is limited and was, for jurisdictional reasons, not the focus of this inquest. However, the University of NSW Transport and Road Safety (TARS) quad bike performance project team estimated that there are approximately 1,400 presentations per annum at hospitals in Australia for minor to severe injuries arising from quad bikes and SSV accidents.

Previous inquests into quad bike related deaths

50. Between 26 May 2003 and 23 February 2007, the Victorian Coroner, held individual inquests into eight quad bike related deaths in both Victoria and Tasmania, over 24 hearing days. The Victorian inquests examined the deaths of:

- Mr Vince Tobin (date of death: 24 January 2002);
- Mr Peter Vaughan Crole (date of death: 17 February 2002);
- Mr John Neville Nash (date of death: 19 May 2002);
- Mr Thomas James Scutchings (date of death: 3 October 2002);
- Ms Elijah Simpson (date of death: 3 October 2002);
- Ms Patricia Murray Simpson (date of death: 30 November 2002);
- Dr Joseph Shepherd; and
- Master Jye Jones.

51. The Victorian Coroner who originally conducted the investigation and heard the oral evidence retired due to illness. Victorian Coroner John Ollie took over the inquest by reviewing the hearing transcripts and delivering findings.

52. Coroner Ollie made the following coronial recommendations:

1) That WorkSafe Authorities in Victoria and Tasmania work with the Victorian and Tasmanian Consumer Affairs Authorities to ensure that quad bikes are not sold to, or operated by, persons who have not completed a Certified Training Program; and

2) That the above authorities investigate, in conjunction with quad bike distributors and Farm Safe, the development of a Certified Training Program along the lines of Honda Australia Rider Training (HART) or the Stephen Gall Ride Smart Ride Safe Programs.

53. In 2013, New Zealand Coroner Shortland held a multiple inquest into the following five quad bike related deaths:

- Mr Carlos Frederick Mendoza (date of death: between 14 – 16 August 2010);
- Mr Grant Charles Cornelius (date of death: 5 September 2011);
- Mr John Roderick McInnes (date of death: 25 September 2010);
- Ms Suzanna Ferguson (date of death: 9 October 2010); and
- Mr Willem Lambertus Van Der Pasch (date of death: 2 September 2011).

54. Coroner Shortland made the following coronial comments and recommendations when he delivered his findings on 23 October 2013:

1) Quad bikes should not be referred to as 'All Terrain Vehicles' because this is misleading. Quad bikes should be referred to by their true definition.

2) Coroner Shortland endorsed the programs and projects instituted by the New Zealand Ministry for Business, Innovation, and Employment regarding supporting guidelines for safe use of quad bikes: that riders must be trained and have the requisite experience to ride a quad bike in performing their duties and functions; to ensure proper judgement is exercised in choosing the right vehicle for the right job; to always wear a helmet; and to prevent children from riding adult quad bikes.

3) Training and education should be continued with the tertiary sector in relation to the New Zealand Qualifications Authority and there should be a review of the appropriate levels of funding to ensure this can occur. Training and education should include:

   a. skills-based training;

   b. hazard identification and management;

   c. an understanding of appropriate quad bike maintenance, including tyre pressures;

   d. a thorough understanding of the limitations and frailties of the quad bike, particularly when after-market attachments like spray units and trailers are attached to it; and

   e. that active riding is one of the most important skills required to safely control a quad bike (and should be taught by qualified people).

   Training should be made accessible to those within the agricultural industry, recreational industry, in forestry, and related industries.

4) It is worthwhile pursuing certification or licensing options for quad bikes and considering whether quad bikes should be registered.

5) That consideration is given to supporting a multi- disciplinary taskforce (within the NZ Government regulator) to specifically research and advise on Roll Over Protective Systems (ROPs) (since entrenched diverse opinions have impeded advancement).

   a. Coroner Shortland endorsed close monitoring of Australian State and Federal advances in the fitment of ROPs and close monitoring of the success from Australia's development and further evidence provided by independent engineers and health and safety experts.

6) Further support should be provided to the Accident Compensation Corporation in their endeavours to fund more research for joint projects and continue to develop scientific approaches to reducing risk, harm and fatalities from quad bikes.

7) Consideration should be given to a specialist unit for quad bikes, tractors and farm machinery to:

   a. conduct regular testing of after-market attachments and products associated with quad bikes, specifically trailers and spray units;

   b. provide better information regarding risk and compromise relating to stability issues of the quad bike;

   c. provide a better understanding of the limitations of a quad bike;

   d. provide a better and safer message within the industry;

   e. develop a better message about quad bike maintenance, in particular correct tyre pressures and general maintenance of quad bikes to reduce risk and fatalities.

8) Consideration should be given to fitting a warning signal by way of alarm or beeper when quad bike is in reverse or on a slope at the potential point of tipping.

55. It is unknown what action, if any, has been taken in relation to the coronial recommendations in Victoria and New Zealand.

Public awareness or regulation?

56. Recommendations made as a result of previous coronial inquiries do not suggest mandated regulation in relation to issues such as training, age restrictions, restriction of passengers, use of helmets etc. However, given the number of deaths that are still occurring, one must question whether it is time for mandatory legislation to be introduced.

57. Accepting there is merit in public awareness programs and education, my view is the time has come for a more regulatory and mandatory framework to be introduced. I accept there may be difficulties in enforcement of legislation in rural situations and on private property and mandating does not necessarily cause changes in behaviour.

58. However, there have been examples where changes in behaviour came out of regulating and mandating safety initiatives. Seat belt use, stronger drink driving legislation, fire alarms and swimming pool fencing are but a few obvious examples that I have seen the benefits of in my lifetime.

59. Mandating legislation will not be popular to some users of quad bikes or many in the agricultural community. However, it sets a standard and provides an incentive to change behaviour. The most tragic cases dealt with in this inquest were those involving children. Many child deaths and injuries occur in the home and often coupled with a lapse in supervision in an unsafe environment. Adults who allow children to have access to a quad bike, need to be aware of the risks they are placing those children in and the potential consequences to themselves due to non-compliance.

Training

Issue 1: Whether existing quad bike training can be improved, standardised and participation more effectively encouraged; and

Issue 2: Whether a mandatory licence or certification scheme should be introduced.

60. It is a relatively uncontroversial proposition to say that proper training and instruction on quad bike use will reduce injuries and deaths. In this respect, there is largely no disagreement from those who were consulted during the course of the inquest.

61. It is evident the handling characteristics and usual operating environment for quad bikes and side by side vehicles are quite different from other motor vehicles.

62. A review of the effect of regulation in the USA by the Consumer Product Safety Commission (CPSC) (the equivalent of the ACCC in Australia) supports a conclusion that quad bike training decreases the rate of serious injuries and deaths.

63. Manufacturers provide clear warning labels on quad bikes and within Owner Manuals, to never operate without proper training or instruction. Anecdotal evidence suggests that many people ignore these warnings.

64. A common thread in all of the nine deaths examined in this inquest was that the riders (including the young children) were all considered experienced quad bike operators by those closest to them. There was no evidence any of the riders had received any formal training.

65. Another common thread was that in all of the cases, the quad bike riders, and where they were children, their parents or supervising adult, ignored 'warned against behaviours' that were outlined in the Owner Manual and prominently displayed on labels fixed on the quad bikes themselves. Most of the riders also made fundamental operating mistakes, and in some cases, displayed errors of judgement.

66. The Australian Competition and Consumer Commission (ACCC) commissioned a quantitative study of quad bike operators in March 2013. The research found that about half of the participants were taught how to ride a quad bike by a family member, friend or neighbour, and a third were self-taught. Although the research found that quad bike operators perceived quad bike riding to be a dangerous activity, they also perceived it to be quite easy. Only 7% of the participants in the study were aware of the concept of 'active riding'.

67. Although manufacturers offer free training in the US with the sale of each quad bike, the level of uptake is apparently low.

68. The FCAI provides an instructional DVD on their website and this is provided to consumers with the sale of most quad bikes. There was some evidence

considered in this inquest that these DVDs are accessed by consumers, although the extent of this is difficult to be specific about.

69. The evidence before me also indicates that cost and access to training in remote settings are barriers for participation in the rural context.

70. Prior training courses offered by the Queensland agricultural sector free of charge (fully funded by Workplace Health and Safety Qld) were over-subscribed, but when partially subsidised training at a fee of around $150 - $200 was offered, the uptake was low.

71. In Queensland workplaces, employers have a general duty under the *Work Health and Safety Act 2011* (Qld) to ensure that employees who operate plant such as quad bikes, as part of their duties, are given adequate information, training, and supervision. There is also a general duty to ensure that an employee is competent to safely undertake tasks allocated to them. How that is achieved is left up to the discretion of employers.

72. The Workplace Health and Safety Qld (WHSQ) coronial liaison officer, Ms Donna Heelan, explained in oral evidence that in general, WHSQ has been moving away from licensing schemes administered by them, and are focussing more on self-assessed competency based training where employers assess the competence of their employees for various machinery.

73. The Qld Department of Transport and Main Roads (TMR) has advised that private property and areas that are not open to, or used by the public for driving motor vehicles are not covered in the Queensland transport legislation. Therefore, there is no requirement in Queensland for an operator of a quad bike that is driven solely on private property or off-road to obtain a certification or licence.

74. Quad bikes and SSVs are classed as 'specially constructed vehicles' under the Queensland transport legislation and some quad bikes are granted conditional registration under this category by the TMR for use on roads and road related areas. However, there is no requirement to undergo mandatory training or to obtain any form of certification or licence, prior to operating a specially constructed vehicle on a road or road related area.

The importance of 'active riding'

75. There were numerous references throughout the inquest, particularly in manufacturer material, noting that for quad bikes to be driven safely, an operator must employ what is known as 'active riding'. Active riding refers to the operator moving their pelvis laterally and/or longitudinally on the seat, or vertically off the seat, while keeping both hands on the handlebars and both feet on the footrests throughout a manoeuvre, increasing the stability of the quad bike, and thereby reducing the chances of a roll over.

76. All stakeholders agreed on the importance of active riding, although there was disagreement about the precise difference active riding makes to the stability of a quad bike, with estimates as low as 10% to as high as 30%.

77. I accept that active riding is important and needs to be learned. Whether it contributes to 10% or 30% stability is not an issue that I can or should make a

finding about. Whatever is the case, active riding should not be held out to be the answer to stability issues.

78. In any event active riding is unlikely to be successfully achieved by children and those who have strength and/or mobility issues, the latter of which are also represented disproportionately in fatalities.

Existing nationally accredited training regime

79. AgriFood Skills Australia is the national Industry Skills Council responsible for skills and workforce development for the agrifood industry. It is currently responsible for the maintenance and implementation of two national units of competency in relation to quad bikes and SSVs.

80. There are currently around 267 Registered Training Organisations (RTOs) registered to deliver the nationally accredited quad bike training packages in Australia. How the RTOs deliver the training is a matter for them. A number of stakeholders were critical of the quad bike nationally accredited training packages administered by AgriFood Skills Australia.

81. The main criticisms stem from the lack of detail with respect to the way in which training should be conducted; the inexperience of instructors; and the possibility that unsafe methods could be taught.

82. It appears that a number of RTOs and non-RTOs, including some manufacturers, are currently offering training packages that are a combination of the nationally accredited competency modules, the Specialty Vehicle Institute of America (SVIA) (the US equivalent of the FCAI in Australia) training package in the US, and their own packages.

83. The FCAI has advised that the US 'ATV Safety Institute' (the teaching division of the SVIA) has a detailed 'off the shelf' training package that could easily be adopted in Australia. The package has core modules focussed on safety, such as the decision making process for pathways to be taken on a quad bike. The FCAI says that additional components for Australian specific conditions and workplaces could supplement the existing package.

84. The SVIA's training package has been developed over many years. It includes a progressive assessment scheme, which the FCAI says could be used for the purposes of assessment for a certification or licensing scheme. The SVIA training package takes about four hours to complete, depending on the level of experience of the group, course numbers, and location.

85. The FCAI has advised that the SVIA has indicated a willingness to provide their intellectual property (in the form of their training packages) free of charge to Australia.

Comments on issues 1 and 2

86. Most stakeholders agree that the existing nationally accredited quad bike and SSV training courses need to be improved; standardised; and participation made mandatory. It is also evident that training should be delivered by licensed and qualified instructors.

87. The majority of stakeholders support the introduction of a licensing or certification scheme, most notably the FCAI and Polaris. The recreational clubs consulted support this, on condition that they are granted access to National Parks or conditional registration for remote road usage. Agforce Qld supports a mandatory training scheme but only if it is accessible and fully subsidised.

88. The Qld Farmers Federation would prefer to see more education, rather than a mandatory training scheme. Office of Fair and Safe Work Queensland would prefer to focus on public awareness campaigns and a system by which employers self-assess the competence of their employees, rather than the introduction of a licensing scheme operated by them.

89. AgriFood Skills Australia has been engaged in providing training and this would now seem to be an opportunity to improve training packages. and in particular, take advantage of the valuable good-will apparent from the manufacturers' offer to utilise existing training packages of the Speciality Institute of America (SVIA) and Recreational Off-Highway Vehicle Association (ROHVA), with the addition of components for Australian conditions and workplaces as required. This should of course be subject to recognition of the intellectual property of SVIA and ROHVA already existing in the programs and that any modifications would need to be made in conjunction with, and approved by, them.

90. It is noted that the FCAI is considering the development of an online or e-learning course as an interim measure whilst these issues are worked through, and that is very welcome.

91. Safe Work Australia (SWA) has stated it cannot develop training packages but can provide input. That is accepted but it is important that a lead agency with federal and state influence be involved in managing the process and keeping it on track, and for that reason I consider SWA should be included in any recommendation.

92. The Queensland Tourism Industry Council has requested that any introduction of mandatory training and/or a certification or licensing scheme take into account businesses who currently operate quad bike tourism ventures.

93. Counsel assisting submitted that although people need to willingly participate in the training, many will not unless it is mandated. The training scheme should be administered by an external agency, not by employers, so that there is a higher level of quality control and standardisation. There should be a recognised qualification that goes with the training, such as a licence or certification. This position is accepted by the FCAI.

94. Enquiries were made with the Queensland Department of Justice and Attorney General regarding whether there were any legal or policy barriers to the introduction of a mandatory training and a licensing or certification scheme, but no response was received. The Department of Transport and Main Roads considers it is outside of its jurisdiction to regulate licencing or certification involving vehicles operated on private land.

95. However, there is ample precedent for government to encroach into the realm of activities on private property when safety is concerned. An example relating to motor vehicles is contained in Queensland's drink driving laws where it is an

offence to operate a vehicle whilst intoxicated, regardless of whether the operation is on a public road.

96. In relation to quad bike tourism, it is accepted there are some issues to work through. The submissions from the FCAI and Polaris that, rather than providing an exemption to tourism operators, the associated risks need to be managed by some form of limited training; have considerable merit and are worthy of consideration.

97. Regarding the cost of training, the manufacturers understandably question why they should be responsible for, or contribute to, the costs associated with training on the basis that no other manufacturer of similar equipment such as motor vehicles, motorcycles, or farming equipment, is required to do so. I agree.

98. Ultimately, the particular State Government agency given responsibility to regulate this aspect of the industry will need to be decided at a government level, if government has the will to so do.

Recommendation 1

It is recommended that Safe Work Australia, the Federal Chamber of Automotive Industries, and the Australian Quad Distributors Association:

a) work with AgriFood Skills Australia to develop an improved and standardised quad bike and side by side vehicle nationally accredited training package.

b) It is suggested that the starting point would be to adopt the 'off the shelf' Speciality Vehicle Institute of America's training packages already in existence, with additional components that focus on particular work environments in Australia.

Recommendation 2

It is recommended that once an improved nationally accredited quad bike training package is developed, the Queensland government:

a) introduce legislation to mandate the completion of the nationally accredited training by all quad bike riders and side by side vehicle drivers, through a certification or licensing scheme.

b) the scheme should investigate whether it is appropriate to provide some more limited standard of training for casual users, for example, in quad bike tourism operations operating in a controlled environment.

c) subsidise the training, including subsidising Registered Training Organisations, to provide the training to remote areas in Queensland to decrease participation barriers; and

d) launch an ongoing public awareness campaign about the importance of quad bike and side by side vehicle training in reducing serious injury and deaths.

e) It is suggested that the Speciality Vehicle Institute of America's model legislation be considered as a starting point for the legislative regime.

Helmets

Issue 3: Whether an Australian Standard should be introduced for quad bike specific helmets; and

Issue 4: Whether wearing a helmet when operating a quad bike should be mandatory.

99. According to the National Coronial Information Database, the most common primary medical cause of death for quad bike related fatalities is head injury (33.3% of all deaths). Of those head injuries, 84% of deceased persons were not wearing a helmet.

100. Dr Terrance Smith, from Dynamic Research Institute in the US, provided a report and oral evidence to the inquest. He cited the results of a number of US studies based on motorcycle collisions. According to those studies, it is estimated that helmets can reduce the chances of brain injury by around 64%, and death by around 42%. Dr Smith noted that when compared with riders involved in motorcycle collisions in the US, quad bike rider collisions report a similar mortality rate but a much higher incidence of head injuries.

101. The latest research in relation to quad bike related fatalities of children in the US was published on 24 November 2014 in the *Pediatrics Official Journal of the American Academy of Pediatrics*, authored by Ms Gerene Denning et al. The research entailed a retrospective descriptive and multivariable analysis of Consumer Product Safety Commission fatality data between 1985 and 2009. That study found that helmets reduce the likelihood of death for children by around 58%.

102. There is currently no requirement to wear a helmet for non-work purposes whilst driving a quad bike or SSV in Queensland.

103. The Queensland Department of Transport and Main Roads grants some quad bike operators conditional registration to operate their vehicles on roads and road related areas. However, their Guidelines do not mandate the wearing of helmets as a condition of such registration. TMR is of the view that their Guidelines do not need to change because most quad bike fatalities occur off road. However, the National Coronial System database suggests that around 18.5% of all quad bike and SSV fatalities actually occur on roadways.

104. There is currently no specific requirement for a helmet to be worn on quad bikes and SSVs in the Queensland workplace. There is, however, a general requirement under the *Work Health and Safety Act 2011* (Qld) for employers to provide a safe work place, which includes the use of personal protective equipment to mitigate risk, where appropriate. Helmets are classed as personal protective equipment.

105. Safe Work Australia has advised that even though some industry sectors claim there are problems such as heat and lack of visibility when wearing helmets, it is unlikely that a person could identify any situation where a helmet was not an appropriate risk control for quad bike or SSV operation.

106. WHSQ has advised that they have provided consistent messaging and guidance material promoting the use of an Australian Standard helmet whilst riding quad bikes; including website information; guidance material and safety alerts. The *Queensland Rural Plant Code of Practice 2004* also states that: *'the use of personal protective equipment such as helmets…should always be worn…'* The Code of Practice is seen as an authoritative guide to employers, used for the purposes of prosecution, if an employer breaches it without an adequate excuse.

107. Only 22% of all deceased persons in the coronial cases within the National Coronial Database wore helmets. The ACCC commissioned a quantitative study of quad bike users in March 2013. Whilst not focussed specifically on helmets, that research found that one in six of the participants never wore any form of protective gear.

108. Anecdotal evidence suggests that a number of quad bike riders consider that helmets are: too hot; too heavy; too expensive; restrictive of vision (making it difficult to see animals for farming purposes, for example); restrictive of hearing (making it difficult to hear animals, or to attach radio devices for communication with helicopters or co-workers, for example); and are not 'cool' or fashionable.

109. Agforce Queensland considered that if these issues were addressed through a more practical helmet design, this would remove a barrier to wearing helmets for some farmers.

110. The World Health Organisation published a manual in 2006 entitled: '*Helmets – A Road Safety Manual for Decision-Makers and Practitioners*'. The manual was compiled by an expert committee and provides evidence, based on the experiences of a number of countries, that setting and enforcing mandatory helmet use is the most effective intervention for reducing injuries and fatalities. The highest increases in helmet use have occurred where the adoption of laws was combined with a public media campaign and strong police enforcement.

111. Over the past 10 years in the US, laws have been introduced progressively in a number of States, to regulate the use of quad bikes and SSVs (including mandatory helmet laws). There has been a corresponding decrease in the number of quad bike and side by side vehicle related deaths, which the CPSC and industry believe are partly attributable to regulatory intervention.

112. The SVIA has developed model helmet laws for consideration by regulators.

Australian Standard for quad bike helmets

113. There is currently no Australian Standard for quad bike specific helmets, only for motorcycle helmets (AS 1698). It should be noted that motorcycle helmets meeting AS 1698 come in many variations and are not necessarily the type of heavy motorcycle helmet designed for high-speed motorcycle riding on roads.

114. New Zealand has introduced a specific standard for quad bike helmets entitled 'All-Terrain Vehicle Helmets' (NZS 8600:2002). The New Zealand standard allows for a lighter weight helmet to be used for quad bike riding primarily in an agricultural environment.

115. Dr Terrance Smith conducted a series of tests on 11 different helmets and was of the view that the New Zealand standard would make no practical difference to the level of protection offered to the majority of quad bike riders. The exception may be for competitive recreational riders who push their vehicles to performance limits. For competitive recreational riders, the motorcycle helmet standard may be more appropriate.

Comments on issues 3 and 4

116. Most stakeholders, including the quad bike industry, representatives of the agricultural community, and representatives of the quad bike recreational clubs, agree that helmet use should be mandatory and that an Australian Standard should be created for quad bike specific helmets based on the New Zealand Standard.

117. WHSQ would prefer to rely on existing general legal requirements for the workplace and on public awareness initiatives, rather than mandatory legislation. However, a range of stakeholders have advised that they have undertaken, with little success, broad public awareness initiatives aimed at promoting the use of helmets by quad bike riders. For instance, whilst completing this decision, I have become aware of another 21 year old fatality in Queensland, driving a SSV for the first time, which has overturned and the driver was not wearing a seat belt or helmet. No training, no seat belt, no helmet.

118. It is accepted that monitoring and enforcement of mandatory helmet legislation in the rural context has challenges but this is no reason to not introduce mandatory use of helmets.

119. If I was asked to set two priorities arising out of the evidence heard in this inquest, it would be mandating helmet use and restricting children under the age of 16 from riding adult size quad bikes. They are essential safety initiatives with almost unanimous agreement of stakeholders consulted in the course of this investigation.

120. Furthermore, the use of a lighter yet safe helmet, models of which were displayed at the inquest, clearly can be adapted to provide for comfort and shade from the sun and in that respect there can be little dispute from those in the farming community that their concerns have not been considered and incorporated.

121. The FCAI and Polaris strongly support a recommendation on both points but have also submitted that the question of the appropriateness of the New Zealand standard needs to be assessed by the appropriate technical subcommittee of Standards Australia before being adopted, and I agree.

122. As to manufacturers subsidising or providing free helmets, I note the submissions from the FCAI and Polaris, which do not support this proposal and for the reasons they have given, I agree this is a matter that individuals or employers should take responsibility for.

Recommendation 3

It is recommended that Safe Work Australia, the Federal Chamber of Automotive Industries and the Australian Quad Distributors Association:

a) initiate the process of introducing an Australian Standard for quad bike specific helmets to meet the needs of the agricultural community.

b) It is suggested that the New Zealand standard entitled 'All-Terrain Vehicle Helmets' (NZS 8600:2002) be considered for adoption after further investigation is completed as to its appropriateness. The standard should provide that competitive recreational riders and road users must still wear helmets that comply with the Australian Standard for motorcycle helmets (AS 1698), or other similar international Standards.

Recommendation 4

It is recommended that the Queensland government:

a) Direct the Queensland Department of Transport of Main Roads to amend their 'Guideline' relating to conditional registration for quad bike and side by side vehicle operation on roads and road related areas, to include mandatory helmet use. For road usage, helmets should comply with the Australian Standard for motorcycle helmets (AS 1698) or other similar international standards.

b) Once an Australian Standard for quad bike specific helmets is implemented, it is recommended that the Queensland government:

   i. introduce legislation to mandate the wearing of helmets (which comply with the Australian standard) by all quad bike and side by side vehicle operators in Queensland; and

   ii. launch an ongoing public awareness campaign about the importance of wearing helmets on quad bikes and side by side vehicles in preventing death and serious injury.

   iii. It is suggested that the Specialty Vehicle Institute of America's model helmet legislation be considered as a starting point for the legislative regime.

Age restrictions

Issue 5: Whether children under 16 years should be prohibited from riding adult sized quad bikes as operators and passengers.

123. According to the National Coronial Information database, 17.1% of all quad bike related deaths were children under the age of 16 years. Some of the child deaths examined in phase 1 of this inquest have not yet been recorded. Of the

24 child deaths recorded, 9 children were under the age of 6. Children as young as 4 years of age have also died on quad bikes in Australia.

124. 54% of the children who died were driving the quad bikes. The rest were passengers. The majority of children who have died were either on adult sized quad bikes, or they were on 'youth sized' quad bikes that were too big for their age category.

125. The latest research in the US found that children under 16 years of age were 12 times more at risk of significant injury compared to adults. Children under 16 account for one quarter of all deaths and one third of all quad bike and SSV related injuries in the US. The study attributed the higher risk of death and injury of children to a number of factors, including physical and mental immaturity, lack of training and experience, operating adult-size quad bikes, riding on roadways, not wearing a helmet, and carrying passengers.

126. The former Queensland Commission for Children and Young People and Child Guardians released a discussion paper in 2009 entitled, *"Keeping Country Kids Safe Discussion Paper".* They found that children in country areas were more likely to die as a result of non-intentional injury and they identified quad bikes as a particular risk for children on farms.

127. The Centre for Accident Research & Road Safety – Queensland (a research centre at QUT) conducted a five-year study collecting detailed crash information and interview data for 43 serious injury cases on quad bikes. Related and subsequent research was undertaken by the Commonwealth Department of Health and Ageing and the Queensland Department of Communities. It was identified by Dr Steinhardt in a PhD thesis drawing on this research that 20 - 25% of quad bike hospitalisations in Queensland involved a rider under 15 years of age.

128. 'Youth sized' quad bikes currently account for around 17% of the Australian quad bike market. Youth sized quad bikes are significantly lighter than adult sized quad bikes and are speed limited. The youth sized quad bikes sold in Australia by the FCAI members comply with the US Standard, which allows for four categories:

- Y6+ for children between 6 and 10 years of age;
- Y10+ for children between 10 and 12 years of age;
- Y12+ for children between 12 and 14 years of age; and
- Y14+ for children between 14 and 16 years of age.

129. In an article in the *Surgical News* (November/December 2013), the Australian Medical College National Trauma Committee noted that children are more vulnerable to serious injury or death from a quad bike accident. They were of the opinion that this was due to a child's inability to react quickly in dangerous situations, a lack of experience and a lower skill level as compared to adults.

130. There is currently no legislative framework in Queensland specifically prohibiting parents or guardians from allowing children to ride adult-sized quad bikes and SSVs (that weigh between 200 – 400kg plus).

131. In the workplace, it is likely that allowing children to ride adult sized quad bikes would be a breach of workplace health and safety regulations in most circumstances.

132. The manufacturers have clear warnings, both within Owner Manuals and on the adult sized quad bikes, that children under 16 years of age should not be operating adult sized quad bikes.

Carriage of children on side by side vehicles

133. The carriage of children as passengers on side by side vehicles was identified as an issue.

134. The current US standard provides that a warning label must be affixed to SSVs as follows:

'Never carry a passenger too small to firmly plant feet on footrests and securely grasp handholds…The passenger must always…securely grasp handholds and plant feet firmly on footrests when seated in the passenger seat.'

135. No age limit is specified in the US Standard. It has been suggested by Polaris that if an age limit for the carriage of children as passengers in SSVs is to be set in Australia, an age range of between 7 – 12 should be considered.

136. Some have called for the introduction of child resistant devices on adult sized quad bikes to prevent children under 16 from driving them. The concept generally involves a device that adds a number of more complicated steps to the start-up process, rather than simply turning the key. Some quad bikes have incorporated such features.

137. Over the past 10 years in the US, laws have been introduced progressively in a number of States, to prohibit children from riding adult-sized quad bikes. Between 2001 through to 2012, there has been a statistically significant decrease in the number of quad bike and SSV related deaths for riders under the age of 16 in the US and it is believed that these laws have been instrumental.

138. The SVIA has developed model age based laws for consideration by regulators.

Comments of issue 5

139. Of all the issues identified for determination in this inquest, the least contentious finding is that it is clearly inappropriate for children under 6 to ride quad bikes of any type and that children under the age of 16 should not ride or be a passenger on an adult sized quad bike or SSV.

140. Although it has been suggested by some that children under the age of 16 should not be permitted to ride *any* quad bike, including youth size quad bikes, there is limited evidence that suggests fatalities have occurred where the correct category of age appropriate quad bikes were involved. Accordingly, it is my view that children between the ages of 6 – 16 should be permitted to ride

'youth sized' quad bikes and side by side vehicles, according to the categories set down by manufacturers, and of course subject to appropriate adult supervision.

141. Mr De Waard has submitted that an age limit of 7 should be adopted for the carriage of passengers on side by side vehicles, to accord with Australian passenger vehicle laws, noting that side by side vehicles have seat belt restraints.

142. Mandatory legislation must be introduced in combination with a public awareness campaign.

Recommendation 5

Noting that children between 6 – 16 are permitted to operate 'youth sized' quad bikes and side by side vehicles, according to the manufacturer's age recommendation for a particular vehicle, it is recommended that the Queensland government introduce legislation to:

a) prohibit children under the age of 16 from operating adult sized quad bikes and side by side vehicles;

b) prohibit children between the ages of 6 and 16 from operating a youth sized quad bike or side by side vehicle, that is not specified to be appropriate according to the manufacturer's age recommendation for that particular vehicle;

c) prohibit children under the age of 7 from being carried as passengers on adult-sized side by side vehicles, as well as any child of whatever age if they are unable to sit with their back against the seat, feet flat on the floor and floor rests, and hands on handholds; and

d) prohibit children under the age of 16 from being carried as passengers on adult-sized sit-astride quad bikes.

e) It is suggested that the Specialty Vehicle Institute of America's age based model legislation be considered as a starting point for the legislative regime.

f) It is recommended that the Queensland government support the introduction of the legislation with an ongoing public awareness campaign about the dangers of parents and guardians allowing children to ride adult sized vehicles and 'youth sized' vehicles that are inappropriate for the age of the relevant child.

Passenger safety

Issue 6: Whether carriage of passengers on quad bikes designed for single operators only should be prohibited.

143. This inquest has examined fatal incidents involving more than one person on a sit-astride quad bike designed for only one driver. Carriage of even relatively light passenger's on quad bikes designed for single operators results in a

different weight distribution on the quad bike, which can adversely affect balance and steering, increase the risk of losing control and cause roll over.

144. Of the fatality cases recorded in the National Coronial Information System database, 10.7% of all roll over quad bike deaths involved two occupants. 2.4% involved more than two occupants. Passengers represented 8.3% of the total number of deceased persons involved in roll overs.

145. The vast majority of sit-astride quad bikes sold in Australia are only designed for a single operator. Sit-astride quad bikes that are designed for a rider *and* a passenger, only account for 0.1% of the Australian market.

146. The ACCC commissioned a quantitative study of quad bike users in March 2013. The research found that about a quarter of users surveyed, rode with someone accompanying them on the same quad bike as a pillion passenger, even though most are designed for only one rider.

147. Manufacturers provide clear warning labels on quad bikes, and the warnings are repeated within Owner Manuals, against carrying passengers on sit-astride quad bikes only designed for one operator. Unfortunately, it is apparent these warnings are often ignored.

148. WHSQ has advised that the general requirements under the *Work Health and Safety Act 2011* for employers to provide a safe work environment and safe use of plant means that quad bikes would need to be operated within the manufacturer's instructions, which includes limitations on the number of persons permitted to use the quad bike.

Comments on issue 6

149. A significant proportion of roll overs are occurring in situations where passengers should not have been carried. Carriage of passengers on sit-astride quad bikes can adversely affect the handling characteristics of the quad bike and increase the chances of roll over.

150. There should, therefore also be the introduction of mandatory legislation (with a public awareness campaign) to prevent the carrying of passengers on quad bikes unless the vehicle is designed to do so. Consumers should be educated about the need to choose quad bikes that are 'fit for purpose', such as considering if a 'Type 2 All Terrain Vehicle' or side by side vehicle may be more appropriate for their expected use.

151. The quad bike manufacturers strongly support mandatory legislation. The SVIA has developed model legislation for consideration by regulators.

Recommendation 6

It is recommended that the Queensland government:

a) introduce legislation to prohibit carriage of passengers on quad bikes other than those specifically designed to carry an operator and a passenger; and

b) launch an ongoing public awareness campaign about the importance of only carrying passengers on quad bikes and side by side vehicles that are designed

to carry a passenger (to reduce the chance of loss of control and roll over) and to highlight the importance of carrying age appropriate passengers in accordance with the manufacturer's recommendations on vehicles that are designed to do so.

c) It is suggested that the Specialty Vehicle Institute of America's age based model legislation be considered as a starting point for the legislative regime.

Operator Protective Systems

Issue 7: Whether the installation of a crush protection device or a roll over occupant protection system is an effective way to minimise deaths from quad bike roll overs; and

Issue 8: If so, whether the installation of such devices and systems could be more effectively encouraged or mandated, where appropriate.

The consequences of roll overs

152. Adult sized quad bikes generally weigh between 200 – 400kg plus. The consequences of such a heavy vehicle landing on an operator are obvious and usually serious.

153. The National Coronial Information System database suggests that roll overs occurred in 60% of total quad bike related deaths. The UNSW TARS team identified that roll overs occurred in 71% of all off-road deaths on farms.

154. Of those farm deaths involving roll overs, 50% were caused by compression asphyxia (caused by the quad bike pinning the person so they could not breathe).

155. After a detailed examination of a number of cases, the UNSW TARS team concluded that 77% of the compression asphyxia deaths would have been survivable if the rider did not remain pinned underneath the quad bike. They found that, unfortunately, the majority of fatal roll overs occur in remote locations where the operator is on their own. All of the individual cases examined at this inquest were unwitnessed and the practical reality is that in farming situations, this will continue to be the case.

Possible solutions

156. Possible solutions being examined at this point in my decision include Rollover Protective Systems (ROPS) and Crush Protective Devices (CPDs). There is strong disagreement between the quad bike manufacturers and those advocating for improved safety, particularly in the rural sector, about the efficacy of these systems. There has been little movement from these respective entrenched positions and this has proved unhelpful.

157. It should of course be noted that this entrenchment in positions is not unique to the Australian context, and apart from some isolated instances where countries

have mandated CPDs, there is no confirmed position internationally, that I am aware of, which has moved the debate on.

158. I do not intend to examine in any detail those entrenched positions and why they have been unhelpful. Nor will I comment on individuals involved in the debate, except where it is necessary. Ultimately, there is a need to move forward and I do not intend to add to the fire with my own views on personality matters.

159. So far in this decision, I have recommended mandating various important regulatory measures, because it can be seen that raising public awareness of those measures has not been enough.

160. The difficulty is that people will continue to ignore warnings about behaviour, even if mandated. Hence the need to continue to explore any possible engineering solutions to protect riders, even when they make bad choices and decisions.

Crush protection vests

161. 'Crush Protection Vests' were not being considered in this inquest until the Director of Dynamic Research Institute in the US, Mr John Zellner, advised in oral evidence that his colleague, Dr Terry Smith, is currently working on a prototype with a US and Canadian company, which could be available to the market within the next year.

162. The crush protection vest under testing is apparently light-weight and flexible, which should make it suitable for use on quad bikes. The benefit of such personal protective equipment (PPE), is that it travels with the operator, so the problem of vehicle dynamics with CPDs fitted becomes a non-issue.

163. It will remain to be seen if this product will be a viable and affordable item of PPE in the workplace. Its development should certainly be encouraged.

Personal locator beacons

164. Considering that farmers often work alone in remote areas, the UNSW TARS team has recommended the development of a suitable 'Personal Locator Beacon', which activates automatically, should a quad bike roll over, to facilitate assistance as early as possible to a rider in distress.

165. The development of such a Personal Locator Beacon should also be encouraged.

What is a roll over protective system (ROPS)?

166. A roll over protective system (ROPS) comes standard with all side by side vehicles (that are certified under applicable US Standards) and the new single seat Polaris Ace (which has been designed to incorporate a ROPS). ROPS are not standard on sit-astride quad bikes.

167. In broad terms, an effective ROPS, according to US Standards, is made up of the following four components:

- a cabin or roll bar structure fitted to the top of the quad bike;
- a bucket seat with a seatbelt restraint;
- occupant lateral restraint surfaces (ie, for the legs, torso and arms); and
- helmets for the occupants.

168. Because a ROPS relies on securing the occupants within a protective space created by the structure during a roll over, they are not used for sit-astride quad bikes. This is because sit-astride quad bikes cannot feasibly have seatbelts fitted, due to the saddle seat set up, and the requirement for the rider to actively ride the vehicle by shifting their body weight around.

169. Rollbar structures (a variant of ROPS, sometimes referred to as Operator Protective Devices – OPDs) for sit-astride quad bikes have been the source of previous investigation. The UNSW TARS team has confirmed that ROPS systems examined by them have an adverse effect on the centre of gravity (and stability) of sit-astride quad bikes.

170. The single seat Polaris Ace does include an integrated ROPS with seat belt and side restraints. Polaris states that this creates a fundamentally different vehicle to an all terrain vehicle (quad bike) because it can no longer be rider-active.

171. At this point in time, most agree that the available after market ROPS for sit astride quad bikes are not considered safe or viable options for protection of the rider. Whether a commercially viable and safe system can be engineered is uncertain and is for the future.

Sit astride quad bike with a ROPS

What is a crush protection device (CPD)?

172. A crush protection device (CPD) (also known as an Operator Protective Device – OPD) is a two bar or circular loop structure attached to the rear of a sit-astride quad bike. Seat belts are not worn with CPDs due to the requirement for an operator to be unrestrained in order to actively ride a sit-astride quad bike.

173. The FCAI argues that their sit-astride quad bikes have not been designed structurally for the fitting of CPDs. In any event, CPDs are not currently fitted as standard to quad bikes by manufacturers or distributors in Australia and must be purchased and fitted after market.

174. The Australian Quad Distributors Association has advised that the Chinese brand, Linhai Motors, and the Australian manufacturer of the 'Quadbar' CPD, QB Industries, have designed and manufactured a CPD for fitting to their main model quad bikes at the point of sale. They have advised that it is intended to release these quad bikes, with CPDs fitted, to Australia in 2015.

175. The two main commercially available CPDs in the Australian Pacific region at the moment are the Australian manufactured 'Quadbar', which was introduced to the market in around 2007, and the New Zealand manufactured 'Lifeguard', which was introduced to the market recently.

Quadbar

Lifeguard

The purpose of ROPS and CPDs

176. ROPS and CPDs do not prevent roll overs. They are engineered controls, which are designed to mitigate against the consequences of a roll over. Their main aim is to limit contact and/or entanglement with the hazard; the hazard

being the kinetic energy and mass of the quad bike. They do this by increasing clearance by creating a 'survival space' under the quad bike as it rolls, so that the operator can crawl out from under the quad bike.

177. A CPD may also limit the number of quarter rolls of the quad bike, which some say facilitates separation of the operator from the vehicle.

178. The manufacturers of the Quadbar and Lifeguard do not claim that their CPDs are useful in all circumstances. All stakeholders, including the manufacturers, agree for example, that a CPD is normally of no use if the quad bike only rolls a quarter of a turn (onto its side).

179. The manufacturers of CPDs also acknowledge that CPDs and ROPS may cause injuries in some circumstances. However, they say that their CPDs provide an overall net benefit.

180. All stakeholders, including the CPD manufacturers, stress the importance of wearing a helmet for general safety purposes, but also in case the operator comes into contact with the CPD or ROPS during a crash.

The use of CPDs in Australia

181. The Director of QB Industries, Mr David Robertson, has advised that since 2007, he has sold around 3,700 Quadbars. The majority are currently being used in Australia, although some have been distributed to other parts of the world.

182. This investigation has revealed that in Australia, Quadbars are being utilised on a relatively large scale by some private companies and government organisations.

183. Tangalooma Island Resort in Queensland has fitted Quadbars to over 100 quad bikes, used by their quad bike tourism operation. The Director of the Tangalooma Island Resort, Mr Trevor Hassard, has advised that around 3,000 tourists ride their quad bikes per month, and since they fitted Quadbars, injury rates have decreased by around 90%.

184. The NSW National Parks Department, has also fitted Quadbars to over 100 quad bikes used by staff.

185. Mr Robertson also provided a number of 'testimonials' where customers have written to him detailing quad bike roll overs they have been involved in where they believe that the Quadbar has saved them from serious injury or death.

The use of CPDs in New Zealand and Israel

186. Professor Tony Lower, the Director of the Centre for Agricultural Health and Safety at the University of Sydney, advised that approximately 10% of all quad bikes in New Zealand have been fitted with CPDs. The research to reach this figure was based on phone surveys conducted by Worksafe New Zealand each year since 2010, where around 800 farmers were interviewed.

187. If that estimate is correct, it is suggested there could be around 8,000 CPDs currently in use in New Zealand.

188. Just before the second phase of the inquest, Professor Lower advised that he had discovered that Israel has mandated the fitment of CPDs (or 'Safety Arcs' as they are known there) to all quad bikes used in their country since the early 90's.

189. Israel appears to be the only country in the world to have implemented such a regulation. Professor Lower was unable to obtain hospital injury or fatality data from Israel but he did obtain a copy of Israel's minimum CPD design standard.

190. Little is known about the Israeli position. Counsel Assisting did write to the Israeli Government on my behalf seeking further information but has received no response. Perhaps they have bigger issues concerning them.

191. Despite the number of CPDs now having been utilised in Australia, New Zealand, and it seems Israel, over an extended period of time, there have been no examples where a person has been seriously injured or killed as a result of a CPD on their quad bike that the inquest has been made aware of. The FCAI and manufacturers dispute this is statistically significant, given the relatively low numbers of CPDs in the context of the total quad bike population. That may be the case, but it is still a fact that needs investigating in the context of a wider evaluation of available CPDs and their impact in relation to safety.

192. If the issues relating to CPDs are to be advanced, an investigation of the Israeli, New Zealand and Australian experiences would be clearly desirable. This is dealt with in recommendation 8.

The trials and tribulations of testing CPDs

193. This issue was the most controversial of the unresolved divergence of views examined during the inquest. That was completely expected and I was again not disappointed.

194. Counsel Assisting has carefully and comprehensively analysed the research in respect of the testing and safety efficacy of CPDs. The consistent position taken by the quad bike manufacturers and distributors has broadly been that CPDs were unsuitable for quad bikes; did not provide any net safety benefit; and, under certain testing they had a net negative safety benefit.

195. The FCAI's position in this respect has not moved. The FCAI denies that its intransigence is due to concerns about potential litigation based on product safety claims, particularly in the USA. It states that it is based on a genuinely-held position that the safety and efficacy of these devices has not been established.

196. I do not intend to pass judgement on these competing claims, but state that the public image and perception of the manufacturers' position is reflected in some of the advertising carried out by the industry on CPDs, and has contributed to a less than positive image.

197. The only way forward is for there to be some genuine collaboration amongst the protagonists to reach consensus on the state of the research, based on scientific methodology.

198. The FCAI, not unreasonably in my view, suggests that the proponents of the efficacy of CPDs, rather than attacking the research conducted by the FCAI (and Mr Zellner and DRI in particular), should be focusing on establishing the safety and benefits of the devices they propose to use.

199. I expect the general public wonder how it can be argued that the installation of a roll over bar would not assist in protecting the rider in the case of a roll over, either side ways or to the front or rear.

200. Unfortunately, at the conclusion of the evidence on this issue, I am left with some concerns about aspects of the research submitted by both sides of the debate, such that I am unable to reach any definitive conclusion. I had hoped to be provided with greater clarity.

201. What can be said from my analysis of the evidence, and this I think is uncontroversial, is that in some circumstances CPDs may protect a person from death or serious injury. In other circumstances, they may not. In yet others, they may even cause serious injuries or death. The argument about the research is as to where the net benefit/risk ratios lie. If there is a net benefit, this means that more lives will be saved and serious injuries avoided than the lives that will be lost or the serious injuries that occur. If there is a net risk or detriment, then the devices will cause more deaths and serious injuries than can be avoided. The terms 'net benefit' and 'no net benefit' were mentioned frequently in the course of the inquest.

202. The position of the proponents of CPDs is there a net benefit, that is, more lives and serious injuries will be avoided by CPDs than occur due to CPDs. However, the quad bike industry states that more injuries and deaths will result, and that is there is no net benefit and possibly a net detriment. The difficulty is that in my view, the research to date has not been capable of defining the level of net benefit or net detriment in a definitive manner.

203. After hearing the evidence and considering the outcome of the research, I do not think that either position can be stated with any certainty, and there has been a degree of overstatement (including in the advertising conducted by the FCAI) from the various sides of the debate of each position. This remains unhelpful as ultimately it is for consumers (and particularly employers) to understand that the research, at best, states there are potential advantages and disadvantages of CPDs, and they should conduct a risk assessment to determine whether a CPD would be suitable in their circumstances. One issue highlighted with some relative agreement from both sides is that such risk assessments should consider whether side by side vehicles, with appropriate restraints and use of helmets, may be a better 'fit for purpose' in many farming and work environments.

204. I do not intend to analyse in detail or depth the history of the testing conducted over the past decade; the scientific papers published; the critical analysis of those papers and the further testing conducted to counter the criticisms. I will make mention of some aspects of the research undertaken with some emphasis on the more recent results.

Research conducted finding support of CPDs

Snook - 2009

205. This research involved releasing a stationary quad bike from a static tilt table test without a rider or a dummy. Unsurprisingly, the Quadbar could be seen to reduce the number of rolls and in certain circumstances create a survival space.

206. The testing was limited to certain circumstances and was considered by Professor Robert Anderson to be unreliable for generalisation purposes.

Dr Richardson - 2014

207. Dr Shane Richardson conducted computer simulation testing of the Quadbar and Lifeguard, as well as quad bikes without the CPD.

208. Dr Richardson found that, in the quad bike and unrestrained rider simulation, the ejected rider was trapped beneath the quad bike and could have been traumatically or mechanically asphyxiated.

209. On the quad bikes fitted with a CPD or ROPS, the riders would have survived the roll over on the Polaris Ace and on the quad bikes fitted with a CPD or ROPS.

210. Dr Richardson noted that his computer simulation tests did have a number of limitations. That may be said about computer simulations generally because they rely on the inputting of data and making assumptions.

211. Whatever may be the case, his research, despite its limitations, was a valid addition to the debate.

UNSW TARS testing of CPDs - 2014

212. The UNSW TARS team identified 55 pinned cases from the National Coronial Information System. Of the 37 pinned cases involving farm work, the TARS team identified that:

- riders were predominantly pinned when the quad bike rolled a quarter turn left or right (54% of pinned fatalities);
- 10 riders were pinned with the vehicle upside down (27% of pinned fatalities); and
- Two riders were pinned with the vehicle upright.

213. The UNSW TARS team conducted static stability, ground contact load, and crash worthiness testing of quad bikes fitted with the Quadbar and Lifeguard.

214. The UNSW TARS project authors concluded:

- the Quadbar and Lifeguard CPDs are not detrimental to the stability or handling of the quad bikes;

- the Quadbar and Lifeguard CPDs are likely to be beneficial in terms of severe injury and prevention of a rider becoming pinned in some low speed roll overs typical of farm incidents; and

- in some specific cases, the Quadbar and Lifeguard CPDs could increase injury, although there is currently no real world recorded evidence demonstrating that a CPD has caused an injury. Multiple controls need to be applied and there is of course scope for improvements to CPD designs in the future.

215. The UNSW TARS team concluded that the Quadbar and Lifeguard CPDs are likely to provide a net benefit by reducing harm to workplace quad bike riders involved in a roll over. They based this conclusion on:

    - An assumption that quad bike overturns in the workplace environment typically occur at low speeds;

    - The results of their limited static and crashworthiness testing; and

    - The absence of any known real world cases where a CPD has caused a serious injury or death.

216. The UNSW TARS team stressed that their support for the fitting of Quadbars and Lifeguards for slow speed workplace quad bikes is on the basis that:

    - A 'fitness for purpose assessment' should always be carried out and consideration be given to substituting a well-designed side by side vehicle for a quad bike. If a SSV is not 'fit for purpose', then a Quadbar or Lifeguard is an engineering control that may improve quad bike safety in the workplace;

    - In some crash events, the Quadbar or Lifeguard could theoretically result in injury, rather than prevent it;

    - Close monitoring and ongoing evaluation of the field performance of the Quadbar and Lifeguard is essential; and

    - More improved, in-depth and uniform quad bike accident data collection forms and procedures are required at state and federal levels, to enable monitoring of the relevant details of quad bike incidents, and the positive and negative effects of CPDs.

217. Counsel Assisting stated that limited weight should be placed on the results of the testing of CPDs by the UNSW TARS team, due to the limitations of their testing.

Quad bike manufacturers' testing

218. My comments here will largely focus on the testing completed by DRI and Mr Zellner.

219. Mr Zellner's involvement appears to have commenced around 1998 when the advice that CPDs were unsuitable was first promulgated. The Australian quad

bike distributors, and subsequently the FCAI, have since adopted that position, and this has been reflected in the FCAI's advertising.

220. The FCAI states it is unaware of any reputable research, worldwide, which evidences that the fitting of a CPD would provide a net benefit to users, submitting the opposite is in fact the case.

221. The FCAI argues that CPDs are unsafe because:

- the key to safety in the event of a roll over on a sit-astride quad bike is rider dismount and successful separation;
- a CPD may obstruct rider dismount and change the dynamics and roll trajectory of the quad bike; and
- A CPD will cause just as many, if not more, injuries and deaths than they prevent, depending on the circumstances of the roll over and the helmet configuration worn by the rider.

222. The FCAI's position against CPDs in general, and the Quadbar in particular, is based on computer simulation testing the FCAI commissioned from DRI and the results of a review the SVIA commissioned of You-Tube footage of quad bike roll overs by a US company Dynamic Research Engineering (DRE).

223. The FCAI's position is that the research conducted by them has found that, for helmeted riders, the least harmful of the CPDs tested (the Quadbar) caused approximately as many injuries as it prevented and was of no net benefit. They stated that more concerning, was that where a CPD was added and the helmet was removed from the rider, the Quadbar caused significantly more injuries than it prevented.

224. The FCAI states that it is inconceivable that anywhere else in the motorised vehicle industry, an unproven device (with no supporting research to demonstrate that it has any safety benefit, but with research indicating the contrary) would be allowed to be fitted to a vehicle, which was never designed to accept it, or that this could somehow be considered to be a 'safety' measure.

DRI testing

225. The first of the DRI studies on quad bikes seems to have occurred as early as 1996.

226. For this inquest I have considered the more recent research, and in particular, computer simulation testing that occurred in 2007 (in the context of the Victorian and Tasmanian inquest) with updates of this study completed in 2012, 2014 and 2015.

227. The earlier reports were the subject of considerable criticism from a number of sources. As a result, Mr Zellner states he addressed some of these criticisms in his later investigations.

228. The FCAI in their submissions conceded there are limitations inherent both in seeking to simulate chaotic events and using a passive dummy rather than an

actual rider. It is also apparent from Mr Zellner's evidence that the computer simulations required 17 variables to be entered and DRI had to make assumptions in relation to, on average, 9 of the 17 variables

229. Because it would be ethically fraught to conduct roll over testing with human riders, and the use of crash testing dummies as they presently exist has its own problems, computer simulations were utilised despite some of the inherent difficulties. In that respect, there can be no criticism of the endeavours to utilise computer simulations.

230. The first series of computer simulated results indicated that installation of the CPD or similar would reduce the potential for chest compression and abdominal penetration injuries, but would also significantly increase the potential for head injuries, and cervical, thoracic and lumbar spinal injuries.

231. In the 2007 research on the Quadbar, there was found to be an overall net injury benefit of the Quadbar, but it was not statistically significant. This was because the injury risks were nearly equal to the injury benefits across the population of the computer simulation samples (and the confidence levels were not high).

232. By 2012, the position had changed somewhat. For the helmeted rider, the Quadbar would cause approximately as many injuries and fatalities as it would prevent, but in the unhelmeted condition, injuries and fatalities were increased and the results were statistically significant.

233. This report was the subject of some criticism by Counsel Assisting and others, because the main body of the report compared the results of a *helmeted* rider on a quad bike without a Quadbar, to an *unhelmeted* rider on a quad bike with a Quadbar. This was said to give the impression that the Quadbar had significant negative effects, when it may have been more reflective of the negative effects of not wearing a helmet. (The comparison of like by like was recorded in an Annexure towards the back of the report).

234. In 2014, a further report was commissioned by the FCAI for this inquest. This found that for a helmeted rider that on average the Quadbar would cause as many injuries and fatalities as it would prevent. For the unhelmeted condition, the report concluded that on average the combination of adding a Quadbar and removing the helmet substantially increased the number of injuries and fatalities.

235. The 2014 report also considered asphyxiation results and concluded that across all simulations, the Quadbar caused the same number of potential compressive / mechanical / traumatic asphyxia / breathing difficulty outcomes as it prevented.

236. Mr Zellner acknowledged in oral evidence that DRI's 2014 'revised' report was produced for the primary purpose of assisting this inquest. He did not concede that the so called 'statistically significant harm' results of the Quadbar in the unhelmeted condition, presented in the body of the report, were misleading or that the comparison between the unhelmeted riders with the Quadbar would have been fairer. Those results were not qualitatively analysed in the body of the report or highlighted as primary results. Mr Zellner conceded in oral evidence that he should have done so.

237. On methodological grounds, Associate Professor Anderson disagreed with DRI's decision to emphasise, as a primary result, the comparison between the unhelmeted rider quad bike simulations and the helmeted rider baseline results. He noted that this comparison confounded two separate effects (ie. the effect of both the removal of the helmet with the addition of the Quadbar). Professor Anderson noted that the other results were actually presented in an annexure towards the back of the report, but he agreed that a reader might get the impression that a quad bar was worse than it actually was.

238. On 26 March 2015, the FCAI provided a further 'supplementary' report. The stated purpose of this supplementary report was to address concerns raised by Professor Anderson during his review of DRI's 2012 and 2014 reports and to address claims made by the UNSW TARS team that the Quadbar may be beneficial for work use on farms in low-speed (20 km/h or less) quad bike roll overs.

239. The supplementary report introduced a third 'half helmet' configuration to the existing full helmeted and unhelmeted configurations that had been simulated previously. DRI also disaggregated what it said were existing calculations to include an analysis by body region; an analysis of the Abbreviated Injury Scale (AIS) scores; as well as for asphyxiation potential. The supplementary report also examined the percentage of roll overs where the Quadbar was 'beneficial', 'had no effect', or was 'harmful'.

240. The analysis of low speed roll overs was conducted by focussing on a subsample of simulations (304 simulations out of the main sample of 770 simulations) with an initial quad bike velocity of less than or equal to 20km/h.

241. The report also utilised additional risk-benefit measuring criteria (rather than the risk/benefit percentage criteria used in earlier reports).

242. DRI's 2015 'supplementary' report made a number of new conclusions:

- In all speed roll overs in the full-face helmet configuration, adding the Quadbar: resulted in a statistically significant net injury risk in terms of neck injuries.

- In all speed roll overs in the half-face helmet configuration, adding the Quadbar, resulted in a statistically significant net injury risk in terms of neck injuries.

- Adding the Quadbar whilst the rider was wearing a half-face helmet caused a statistically significant net injury risk in terms of the total number of maximum AIS 6 injuries across all body regions (ie. critical injuries to body regions of the head, neck, chest and asphyxia that result in a high fatality probability).

- In all speed roll overs in the unhelmeted configuration, adding the Quadbar, caused a statistically significant net injury risk in terms of the normalized injury cost across all body regions.

- In low speed roll overs in the full-face helmet configuration, adding the Quadbar, did not result in any statistically significant net harm or benefit.

- In low speed roll overs in the half-face helmet configuration, adding the Quadbar, caused a statistically significant net injury risk in terms of neck injuries.

- In low speed roll overs in the unhelmeted configuration, adding the Quadbar, caused a statistically significant net injury risk in terms of injuries across all body regions.

243. One of the anomalies in the 2015 report is in relation to different helmet configurations. For example, there are no statistically significant net harms or benefits reported for the Quadbar at low speeds in the full-face helmet configuration, but for the half face configuration, there was a statistically significant net injury risk in terms of neck injuries. At high speed, neck injuries increased at the same rates for full face and half face helmets.

244. DRI endeavoured to explain the anomalies relating to the significantly different result between the full helmet and half-face helmet configurations, as follows:

- greater head protection by wearing a helmet reduces the number of head injuries;

- there were different trajectories of the dummy's head and body due to progressively greater helmet mass and size; and

- there is a potential load transfer (or 'bridging') effect when a quad bike lands on the dummy's head or helmet.

245. Despite these explanations, the significant differences in results between the full helmet and half helmet configurations just do not make sense to me.

246. At the same time as presenting the latest research report, the FCAI provided a further report from DRI entitled: *Full Scale Overturn Tests of an ATV with and without a "Quadbar" CPD using an Injury-Monitoring Dummy*.

247. The stated purpose of the report was to document the results of V-ditch and J-turn full scale tests with a Motorcyclist Anthropometric Test Device (MATD) dummy (to be used to further calibrate DRI's computer simulation model). The quad bike was equipped with a control system that allowed the quad bike's steering, braking, and acceleration to be operated via remote control.

248. The MATD dummy was fitted with a medium half-helmet because it was believed to be more compatible with the thermal environment associated with farming activities.

249. The testing conducted compared the reaction of a 'baseline quad bike' without a Quadbar fitted and one with a Quadbar fitted to two different scenarios being the V-ditch test and J-Turn test. Both overturn scenarios were intended to replicate low speed and low energy conditions. The goal of the physical testing was to induce a roll over of at least two-quarter rolls in the baseline configuration.

250. A series of runs were made in order to achieve a matched pair of speeds, roll over location, dummy posture, and fully functioning instrumentation suite. Eventually, a pair of tests with matching speeds and relatively similar

conditions was run, one with a baseline quad bike and one with a quad bike fitted with a Quadbar. The baseline quad bike was traveling at a slightly lower speed at the point of overturn.

251. DRI's conclusions for both 'full scale' physical tests (on the 30 degree slope and on the flat terrain) were as follows:

- The injury levels were zero for all testing, with and without the Quadbar, for all body regions;
- In both scenarios, the quad bike fitted with the Quadbar came to rest sooner (after three quarter rolls), compared to the quad bike without the Quadbar (after four quarter rolls); and
- In both scenarios, the quad bike fitted with the Quadbar came to rest on top of the dummy ('pinning' the dummy), whereas the quad bike without the Quadbar achieved complete separation from the dummy.

252. DRI claims in its report that although the injury values were zero, the final resting position of the quad bike fitted with the Quadbar in each scenario may indicate a potentially life-threatening condition, because depending on the circumstances, very small variations could have resulted in head or neck injuries, or asphyxia. In addition, human riders may not be able to extricate themselves from underneath the quad bike when pinned in this manner.

253. DRI pointed out in their report that in the scenarios involving the quad bike without the Quadbar, the dummy was not necessarily injured when the quad bike rolled over and beyond them.

254. DRI acknowledged in their report that the quad bike fitted with the Quadbar did briefly preserve a 'survival space' beneath the quad bike while it was upside down and in motion. However, they stressed that the dummy did not remain in this space, and was in fact eventually pinned under the quad bike.

255. DRI claimed in their report that because the Quadbar arrests the motion of the quad bike, rider separation may be hindered, increasing the likelihood of the quad bike coming to rest on the rider.

256. In oral evidence, Mr Zellner was challenged by Counsel Assisting on a number of aspects as to the reliability of the results of the report in proving that the Quadbar was more harmful on a number of grounds, the majority of which he accepted.

Research by Design Research Engineering

257. In 2012, a team led by Dr Chris Van Ee at Design Research Engineering Inc (DRE) in the US undertook research commissioned by the SVIA in which YouTube videos of actual quad bike roll over incidents were examined.

258. The aim of the examination was to quantify and analyse quad bike roll over dynamics and rider responses for real world incidents. It was intended that the data would be used to guide effective design and implementation of injury mitigation strategies. He was of the opinion that accurate evaluation of a CPD must be grounded in real world quad bike and rider dynamics across the range

of incident scenarios that commonly occur. Dr Van Ee stated that one of the largest challenges in the evaluation of CPD effectiveness is defining the position and movement of the rider during the accident sequence.

259. Dr Van Ee pointed out that physical testing and computer simulations were limited. Dr Van Ee's YouTube study was intended to bridge these gaps. His team collected, categorised and analysed 129 quad bike roll over events from YouTube.

260. DRE made a number of conclusions as to the types of rolls, number of rolls and speed at the time of the rolls. Dr Van Ee noted that 80% of the roll overs occurred on sloped terrain. He noted that 85% of roll overs were operating in unsafe conditions, including riding on a hill with more than a 25 degree slope. He believed that the primary contributing factors for the roll overs were as follows:

- 46% due to rider input (eg. braking, throttle, steering); and
- 43% due to terrain effects (eg, local features such as a bump or ridge, with many events occurring while driving up a steep hill).

261. No injury was identified for 79% of the roll over events. In those cases where injuries were noted none of them involved serious injury and most were contact injuries in various configurations. The overall injury rate for riders attempting active dismount was 15% as distinct to 32% for riders who did not attempt active dismount.

262. Dr Van Ee was of the opinion that his investigation confirmed the importance of active rider movements, including active dismount and subsequent separation in determining the outcome of quad bike roll events.

263. Dr Van Ee claimed that a rear mounted CPD may obstruct rider dismount and successful separation. In addition where riders had minor or non-injury outcomes, the presence of a CPD would likely have resulted in CPD-rider contact, new quad bike rider contact scenarios, and/or a change in the dynamics and roll trajectory of the quad bike.

264. Dr Van Ee conceded there might be some selection bias inherent in videos that are posted on YouTube and in particular videos posted would be less likely to include serious injury and fatal scenarios.

265. Dr Van Ee and his team were commissioned by the FCAI to conduct a further investigation in relation to the possible obstruction that a Lifeguard CPD could represent to quad bike riders attempting an active dismount. Unsurprisingly, he came to a similar conclusion.

266. Dr Van Ee concluded that given the current knowledge of the effectiveness of active dismount and separation in roll over situations, and the potential of a CPD to obstruct effective dismount, great caution is warranted in the implementation of any such device. The effectiveness and unintended consequences of CPDs for roll over protection needs to be adequately addressed with reliable field and dynamic test data.

Associate Professor Anderson's review of DRI's 2012 and 2014 computer simulation reports on the Quadbar

267. The FCAI commissioned Associate Professor Robert Anderson to review DRI's 2012 and 2014 reports regarding the Quadbar. Extracts of the 2015 'supplementary' report that DRI was also working on at the time seems to have been provided to him for the purposes of his review.

268. Associate Professor Anderson noted that with such computer simulations, there is a reliance on the skill of the modellers and the validation of the model to ensure that simulations perform in a sufficiently valid way. Where simplifications are necessary in a model such as this, the main consideration is that the model retains fitness for purpose. The degree to which a model provides useful information often depends on the experience of the modellers, and their knowledge of which aspects of the model will be influential on the results.

269. Associate Professor Anderson made the following general conclusions:

- There would be little or no systematic bias because DRI elected to perform a matched pair comparison (where the same roll over scenarios were modelled with and without the Quadbar), which meant the effects of specific modelling choices would have applied to both simulations in each pair;

- He did not see any specific behaviour in the simulations which led him to think that any characteristic of the models had been miss-specified in a way that would suggest that positive Quadbar effects were being masked by the simulations;

- The computer simulated model had been validated to a reasonable extent against full scale tests, based mainly on the kinematics of the quad bike and rider in a roll over; and

- Even if other areas of the model were found to be incompletely validated, it was unlikely that the comparison of effects would be materially affected because some aspects of the dynamic behaviour of the model would apply equally to simulations with and without the Quadbar.

270. Associate Professor Anderson noted past criticisms that DRI's computer simulations involved excessively high energy levels and were not representative of reality. He reasoned that because the modelling exercise had now been performed twice with various aspects of the simulations varied between the two exercises (including the energy levels considered), and given that the general direction of the results did not change materially, it was likely that the results could now be more confidently generalised than they could before. However, if it was found that Quadbar effects varied significantly by scenario, then it would become important to consider whether the scenarios selected were sufficiently representative of serious and fatal crashes in Australia.

271. Associate Professor Anderson noted that DRI had proposed a null hypothesis: that the presence of a Quadbar had no effect on the mean values of the injury risk / cost metrics. The statistical test used failed to reject the null hypothesis,

because the simulations could not show an unambiguous effect of the Quadbar on the average injury risk in the simulation. However, Associate Professor Anderson cautioned against any interpretation that because the null hypothesis could not be rejected, this constituted a confirmation of the null hypothesis (ie. that the Quadbar had no positive effect).

272. In Associate Professor Anderson's opinion, the results for the unhelmeted condition might be considered weak evidence that a Quadbar might provide a small net benefit in the simulation cases where the dummy was not wearing a helmet. However, Associate Professor Anderson agreed with DRI that this result needed to be considered in the context of misuse in general, and that no encouragement should be given to quad bike riders to ride without a helmet.

273. Associate Professor Anderson found two deficiencies in the comparison between the injury distributions in the real world incident data and the computer simulation data. The first was that the comparison focussed on the distribution of severity in each body region rather than the distribution of injuries across the body. The second was that the statistical test applied over-emphasised the similarity of the distributions, whereas a simple examination of the distributions suggested substantial differences, particularly in the case of head injury distributions.

274. Associate Professor Anderson noted that criticisms that the DRI results were not representative of actual quad bike incidents and therefore not representative of real injury risks might have some merit. However, it was not clear to him whether any potential shortcoming in this respect would change the direction of the results.

275. Associate Professor Anderson noted that DRI's 2012 report concluded a very high correlation between injury severities in the UK and US accident database samples and the injury severities predicted in the computer simulation data. An examination of the distributions by Associate Professor Anderson suggested substantial differences, particularly in the case of head injury distributions.

276. Associate Professor Anderson was more satisfied with the different statistical approach taken in the 2014 revision of the report because the statistic used (model efficiency) better reflected the similarities and differences between the two distributions. Associate Professor Anderson stressed though, that the 2014 computer simulated results still showed poor correlations in some instances, particularly for head injuries in the unhelmeted simulations.

277. In Associate Professor Anderson's view, the improved disaggregated data by body region provided by DRI in an extract of their supplementary 2015 report provided some additional insights into the results of the simulations, as follows:

    - The overall result was a non-statistically significant net benefit of the Quadbar in the unhelmeted rider simulations of 12%;

    - When the results were filtered by severity, the general features of the results were similar to the unfiltered results. There were Quadbar benefits for the head, neck and lower extremities, but not for the thorax and abdomen;

- There were relatively few thoracic injuries predicted, and high severity injuries were dominated by head and neck injuries. This was somewhat at odds with injury data reported by Ms Angela Clapperton et al in their published article entitled 'Quad bike – related injury in Victoria (MJA 199 (6) 2013) (Exhibit H1.2) where severe injuries to the thorax and head were more equally represented; and

- For the helmeted simulations, the results were similar, except that head and neck injuries were much lower, and the Quadbar tended to increase the number of head and neck injuries. Thoracic injury risks are also under-represented in the helmeted situations.

278. Associate Professor Anderson noted that thoracic injury risk may be worthy of further investigation but that the effect of the Quadbar on the thoracic injury risk in these simulations was negative and adjustments to the simulation model might actually increase the negative effect of the Quadbar in the simulations.

279. I have to say that Associate Professor Anderson gave careful and considered evidence and certainly his overall opinion appears to accept that DRI's research should be considered a valid and reliable addition to the research that was available.

Proposed technical standard for CPDs (2014)

280. Safe Work Australia commissioned Mr Andrew McIntosh, from Consultancy and Research Pty Ltd, to develop a draft technical specification for quad bike CPDs. Mr McIntosh was a member of the UNSW TARS quad bike performance project team that assessed CPDs.

281. In the first part of his report, Mr McIntosh provides an overview of previous testing of CPDs, the results of the UNSW TARS testing of CPDs, and then provides an opinion based analysis of the likely effects of a CPD in different roll over scenarios. Mr McIntosh shares the opinion of the UNSW TARS team that CPDs offer a moderate, but limited, benefit to the operator in a roll over, especially in low speed roll over events. He concedes that there are discrete risks associated with CPDs in high-speed roll overs. He concludes that properly constructed CPDs would offer a net benefit.

282. In the second part of his report, Mr McIntosh used his analysis of CPDs to develop very detailed technical guidance on the requirements for safe design, construction, and installation of CPDs for quad bikes of a mass of less than 560kg.

283. Mr McIntosh has provided Safe Work Australia with a set of draft specifications that can be applied uniformly in a future standard for the manufacturing of CPDs. Mr McIntosh says that adoption of his proposed standard will provide quality assurance, and ensure that CPD structures are capable of withstanding the load likely to be imposed on them, and reduce the risk to the operator during the roll over.

Comments on issues 7 and 8

284. I have formed a view that the research from all sources has sufficient inherent difficulties and statistical inconsistencies for me to be able to reach a conclusion about the efficacy of CPDs in particular.

285. That does not mean the research from all sources to date is invalid or should be disregarded. To the contrary, what is needed is for the researchers to collaborate and examine the evidence in a scientific fashion, unhindered by entrenched positions that are so evident in the debate to date. In that respect, someone such as Associate Professor Anderson might be a person who could lead further research and collaboration between researchers such as Mr Zellner and those at TARS, if funded appropriately, and bring back some balance to the scientific debate.

286. I am not convinced that CPDs as they currently exist on the market, or as a concept, should be thrown on the scrap heap as would be suggested by the FCAI. The testing does suggest there are a number of circumstances in which roll overs occur where a CPD, especially where low speed features (as occurs typically in a farming context), may save a person from death or from suffering a serious injury. In other circumstances, they may not, and they may even cause serious injuries or death. The sting is that the circumstances where benefit or detriment may or may not occur, cannot be stated at this time in sufficient clarity for me to make a finding.

287. Consumers, and in particular, employers, need to be able to receive authoritative information about the potential advantages and disadvantages of CPDs, so they can conduct a risk assessment to determine whether a CPD would be suitable in their circumstance.

288. What is now required is for there to be an independent move to develop an Australian Standard for quad bike CPDs. In doing so, there will inevitably be a need to continue on from the existing research and ensure such a design meets the purpose of providing a safety benefit. I note Polaris' concern in that regard but I take that as read. I agree that further research should be conducted on the efficacy of currently available CPDs and that research should be independent.

289. I note Safe Work Australia has been extensively involved in commissioning reports on quad bike designs and CPDs, and in my view, is best placed to advance that work further with some degree of independence. If not specifically managed by Safe Work Australia, SWA should remain in an overseeing role. There will no doubt be resource implications, which will need to be funded and that is a matter for state and federal government.

Recommendation 7

It is recommended that Safe Work Australia:

a) manage or oversee the development of an Australian Standard, or the like, for crush protection devices fitted on sit-astride quad bikes in Australian workplaces.

Recommendation 8

It is recommended that Safe Work Australia and the manufacturers of the Quadbar and Lifeguard:

a) fund an independent survey study of all persons who currently use the Quadbar and Lifeguard crush protection devices to obtain 'real world' feedback regarding their effectiveness. (The study could also potentially be expanded to consider the estimated 10% of the New Zealand quad bike population who are believed to be utilising crush protection devices); and

b) develop guidance for workplaces to assist them in conducting a more informed risk assessment as to whether a crush protection device is appropriate for their situation.

Recommendation 9

It is recommended that the manufacturers of the Quadbar and Lifeguard crush protection devices:

a) provide their customers with written guidance about what to do in the event of a roll over where their crush protection device is fitted.

Quad bike safety design standards

Issue 9: Whether an Australian Design Rule or Australian Standard based on American National Standard (ANSI-1-2010) should be mandated for the manufacture, import and supply of quad bikes in Australia.

A 'safe systems approach' requires a focus on safe quad bike design

290. At the commencement of this decision, I referenced the discussion paper released by Australia's then Federal Minister for Employment and Workplace Relations in August 2012, where the following statement was made:

> *"For over 20 years the focus on quad bike safety in Australia has been on other approaches like training and education, awareness raising and helmet use to address the high number of fatalities and serious injuries sustained by quad bike riders. The time has come to focus on design and engineering controls for improving quad bike safety".*

291. This statement captures the mood of many stakeholders who were consulted as part of this inquest: that in order to apply a 'Safe Systems Approach' to quad bike safety, it is time to address the issue of the design of quad bikes.

292. The Managing Director of KND Consulting Pty Ltd and UNSW TARS team member, Mr Keith Simmons, and others, have pointed out that the 'Safe Systems Approach' is internationally recognised best practice for managing and improving road safety. The Safe Systems Approach recognises that

people will make mistakes and that crashes will occur, but the punishment for making a mistake should not be death or serious injury. The focus should be on safer people (through training and education), but also on safer vehicles (that are forgiving of minor lapses in attention, minor errors of judgement, and that mitigate against injury risk if a crash occurs).

293. It is in this part of the inquest that the divergence of views on many of the technical aspects of the evidence also became particularly apparent. The TARS team and associates who presented their reports and evidence were subjected to extensive cross examination by counsel for the FCAI on a multitude of issues.

294. These issues have been extensively raised in the FCAI submissions, which are critical of many aspects of the research, methodology and findings of anyone but their own experts. They were critical of the level of expertise of the witnesses and the relevance of their qualifications.

295. Whilst the FCAI indicated support for some of the recommendations, the level of disagreement is such that any hope that industry would move forward on this issue alone is fanciful. Hence, although industry participation is essential, it needs to accept that there are other views and take a more collaborative approach than the combative approach taken in the past.

Current reliance on US Standards

296. There is currently no Australian or state based regime in place, which mandates a minimum design and safety standard for quad bikes or side by side vehicles sold in Australia. The FCAI and AQDA members (and Polaris) currently distribute quad bikes of manufacturers who comply with US standards. Their compliance with the US standards in the Australian market is a voluntary decision by those manufacturers.

297. With the influx of other imports it may be time that consideration be given to adopting an Australian Standard reflective of the predominant use in Australia and Australian conditions. It should be noted that I have not received any evidence that suggests there are any particular concerns regarding imports from other sources over and above the issues of quad bike design generally.

298. Reference was made during the course of the inquest to the existence of other international standards such as the British and European standards that should also be considered.

299. As part of the Safe Work Australia quad bike consultation process in 2012, a range of stakeholders asserted that quad bike stability was an issue but the US standard did not include any lateral (sideways) stability requirements for quad bikes. They were of the strong view that a lateral stability requirement should be included in any future implementation of a design standard in Australia.

300. Since roll overs are a major contributor of fatal and serious injury outcomes involving quad bikes, the focus of the TARS project was to consider measures aimed at reducing both the incidence and severity of such incidents.

301. The UNSW TARS project emphasised the importance of engineering control measures, which design out the hazard. The quad bike Industry have and still

maintain a position that further in-depth injury data relating to the characteristics of quad bike and SSV roll over crashes to vehicle stability, handling and crashworthiness design, is essential before any design changes should be considered. Whilst the UNSW TARS team agreed this would be of benefit, they disagreed that this should hold up safety advances in vehicle design. They considered that until such data could be obtained, the principles established over the past 50 years in mobility safety for all vehicle types could be usefully and appropriately applied to quad bike and SSV safety design.

302. The authors of the TARS report urged that a pro-active approach should be taken, rather than waiting another decade until such data may become available, and in the meantime casualties would still be occurring.

303. The UNSW TARS team concluded, as a result of their static and dynamic handling testing, that:

- the roll over resistance of quad bikes is typically low, and provide low margins of safety against roll over, particularly when compared with side by side vehicles;
- carriage of small loads adversely affects a quad bikes stability more than that of a side by side vehicle;
- in terms of dynamic handling, side by side vehicles generally had more forgiving handling and higher stability characteristics and were less reliant on the operator's vehicle handling skills than quad bikes; and
- quad bikes without a roll over protection system have a limited ability to prevent severe injury risk in low and high speed roll overs, although this also applies to poorly designed side by side vehicles with substandard roll over protection systems and inadequate seatbelts and interlocks, and poor containment to prevent partial ejection.

304. The UNSW TARS team noted that quad bike and SSV design can be improved for increased stability and dynamic handling and referred to their testing of a prototype quad bike.

305. The UNSW TARS team recommended that:

- quad bike track width be increased to significantly improve roll over resistance;
- quad bike driveline and suspension systems be modified to significantly improve roll over resistance and handling;
- side by side vehicles have seat belt interlock systems installed, so that the vehicles are either disabled or will not travel more than10km/h, if seat belts are not locked in. This is to ensure the effectiveness of the ROPS;
- the US Standard relating to side by side vehicles should be upgraded to include a dynamic roll over crashworthiness test for occupant containment and protection; and

- a thorough evaluation program should be developed to determine whether further safety improvements to the US standards are required.

Draft design 'requirements document' for workplace and on-road quad bikes

306. Following on from the Workcover and ACCC funded UNSW TARS project, Safe Work Australia commissioned Mr Keith Simmons to develop a draft Design 'Requirements Document' for quad bikes. He provided his draft to Safe Work Australia in December 2014. Safe Work Australia provided a copy of the draft for use during the inquest, but on a confidential basis.

307. The purpose of the draft Requirements Document was so that the draft document could be used by Safe Work Australia in the future, as a tool to consult with affected stakeholders, such as the industry, in the development of a potential quad bike design standard.

308. It is important to realise that the draft Requirements Document was only intended to apply to quad bikes designed, sold and purchased for use in a workplace and for those quad bikes seeking to be conditionally registered for on-road use. There was no intention at the developmental stage that the document would impose design or usage restrictions on quad bikes sold for the purpose of competitive use or aggressive / spirited recreational riding. This is because different performance and handling characteristics may be desired by the operator for the more competitive recreational settings.

309. The draft Requirements Document was developed to match as closely as practicable, and builds upon, the latest US standard and European equivalent. However, the draft document also includes specific safety requirements identified in *European Regulation 168/2013 of the approval and market surveillance of two or three wheel vehicles and quadricycles*. Significant variations to the US Standard have been proposed by Mr Simmons.

310. In oral evidence, Mr Simmons explained that his recommendations were based on his observations during the UNSW TARS project static, dynamic, and crashworthiness testing. Mr Simmons also based his recommendations on fundamental engineering principles, and his analysis of the causes of roll overs and loss of control in the real world Australian fatality data studied by the team. Mr Simmons rejected the FCAI's suggestion that the link drawn between static stability and reduction of roll overs in on-road passenger and truck vehicles had no applicability to quad bikes and SSVs because they predominately operate off-road. Mr Simmons conceded that in many cases, there was no direct link between design features such as stability and steering configurations with reported quad bike injuries and deaths. The link was really based on indirect evidence because in many cases the direct data just simply does not exist.

311. Mr Simmons' report recommends that the draft Requirements Document be subjected to public discussion prior to implementation, to ensure the impact on manufacturers, user groups and consumers, is fully understood and considered prior to its introduction.

312. He also recommended that further research be conducted into the relationship between the vehicle bump obstacle response and real world loss of control

incidents, and that complying quad bikes are monitored into the future to confirm that the safety standard remains suitable.

Exponent report on recreational off-highway (ROV) handling and control (2012 and 2015)

313. Mr Graeme Fowler, the Principal Engineer of US company Exponent Inc provided a report and gave evidence at the inquest.

314. The purpose of Mr Fowler's report was to critique the suggestion by Mr Simmons that the traditional quad bike configuration transition from understeer to oversteer (US-OS) is not conducive to good controllability, and that workplace and on-road quad bikes should be designed with a slight understeer steady-state handling response similar to passenger cars.

315. The report included an evaluation of quad bike handling in which experienced quad bike riders operated a quad bike in different steady-state cornering configurations (a configuration which produced a linear understeer (labelled 'US') and another configuration transitioned from understeer to oversteer (labelled 'US-OS').

316. Although the primary conclusion supported the understeer to oversteer configuration, the testing focused on subjective feedback from experienced recreational riders who would have been used to riding vehicles with a US-OS steering configuration. To that extent, it was of limited value, but needs to be considered in the mix of research.

Should an Australian Standard be developed?

317. It is my view that the preference would be that an Australian Standard be developed and adopted for the design, manufacture, import and supply of quad bikes and side by side vehicles. By practical necessity, the US standard must be the starting point, and despite misgivings from some, it was generally agreed that adopting the US standard would be better than nothing.

318. However, the process for adopting a standard requires an exhaustive process of consultation. The participation and ultimately the agreement of manufacturers would be essential. The process may take many years.

319. The FCAI is currently supportive of the adoption of the existing US Standards into an Australian Standard. The cross examination at this inquest and in particular the submissions of the FCAI are indicative that it is most unlikely they would support any substantive changes relating to design at this point. But at least an Australian Standard based on the US Standard would set the minimum requirements for future imports, which currently do not need to meet any standard.

Other design regulations

320. In counsel assisting's submissions, he referred to the possibility of the adoption of an Australian Design Rule or alternatively a Vehicle Standards Bulletin (VSB), both of which can be regulated through the Commonwealth *Motor Vehicle Standards Act 1989* (MVSA).

321. For the reasons he sets out, I accept these are regulatory paths that may be considered in the future, depending upon the outcome of other pathways.

Comments on issue 9

322. This inquest heard about the design standard changes currently being proposed by the UNSW TARS team and Mr Simmons. There was significant disagreement between the manufacturers' experts and TARS and others about the link between those proposals and safety and the practical effects such design changes would have on mobility and safety.

323. Most of the evidence revolved around highly technical issues not capable of a resolution in an inquest context. To move forward, further work needs to be done in the area of quad bike and SSV design.

324. Safe Work Australia has taken the initiative and sought to lead this issue by commissioning a Design Requirements Document and otherwise has been closely involved in the review of quad bike safety. This is very much a federal issue and given Safe Work Australia's membership includes state and territory as well as industry representatives, and its important role in developing national policy, I consider it is important for it to become a major player in informing the debate.

325. What should now occur is for Safe Work Australia to consider the evidence before it and the proposals it has received; and, in consultation with the industry, determine whether an Australian standard of some sort is required for workplace quad bikes and on-road quad bikes. I accept recreational use is outside of its mandate and in any event this inquest is not proposing that quad bikes for recreational use should be subject to the same standards.

326. In the meantime, for all quad bikes and SSVs, having an Australian Standard is better than none at all.

Recommendation 10

It is recommended that the Federal Chamber of Automotive Industries and the Australian Quad Distributors Association:

a) initiate the process of developing an Australian Standard through Standards Australia, in consultation with relevant stakeholders, for the design, manufacture, import and supply of quad bikes and side by side vehicles to Australia.

b) It is suggested that the Australian Standard should be based on the US Standard.

Recommendation 11

It is recommended that Safe Work Australia:

a) consider whether a different safety standard is required for workplace and on-road quad bikes. If so, it is recommended that Safe Work Australia initiate the

process of either an Australian Standard, or a Vehicle Standards Bulletin, in consultation with the industry and other relevant stakeholders.

Increased consumer awareness (Star-Rating)

Issue 10: Whether the introduction of a star rating system (similar to the Australian New Car Assessment Program) would assist consumers to choose quad bikes that are fit for purpose and to further encourage safety innovation by industry.

Current situation

327. The majority of stakeholders advocate for better consumer awareness in relation to choosing quad bikes and side by side vehicles that are 'fit for purpose', as a way to increase safety.

328. WHSQ currently provides some information to workplaces about the 'fit for purpose' concept but the level of information given to consumers by quad bike distributors appears to vary depending on the distributor.

329. There is currently no easy way for consumers to judge comparative safety of quad bikes and SSVs.

The star-rating concept

330. The UNSW TARS team has proposed that a five star rating system be introduced for quad bikes and SSVs (the 'Australian Terrain Vehicle Assessment Program (ATVAP)'), similar to star rating system in place for passenger road motor vehicles (the Australasian New Car Assessment Program (ANCAP)).

331. The objective of the star rating system would be to introduce a robust, test based rating system, in order to provide workplace and consumer based incentives for informed, safer and appropriate vehicle purchase (highlighting 'fit for purpose' criteria), and at the same time generate corresponding incentives and competition amongst the quad bike and SSV industry for improved, safer designs and models.

332. The UNSW TARS team have noted that the use of star rating systems to inform consumers has been widely used and accepted by the general public, stakeholders and many other industries, including the successful ANCAP system for passenger vehicle safety. They argue that ANCAP has been a catalyst for large technological safety advances that have delivered major safety benefits by reducing community trauma in the case of road vehicles.

333. The star rating system, as it is currently proposed, focuses largely on reducing roll overs in the workplace. It is not so much focussed on the competitive recreational quad bike and SSV riders. It is based on a premise that quad bikes and SSVs with a higher resistance to roll over and improved roll over

crashworthiness will result in reduced roll over related fatalities and serious injuries.

334. The UNSW TARS team states it has designed a testing and rating system, which they say proves that, contrary to industry opinion, quad bikes can be subjected to scientifically reliable, repeatable, and meaningful crashworthiness, static and dynamic handling tests.

335. The UNSW TARS team has recommended that the ATVAP Rating system should sit within ANCAP, and that the ATVAP rating should be listed online. The detail of Professor Grzebieta's testing criterion and processes were subjected to a great deal of criticism by the FCAI's experts during the inquest. Professor Grzebieta stressed that the system they have proposed is not perfect, but it is a good start. He stated he would be open to further consultation with the industry in terms of the detail. He has proposed that the program, if implemented, would be evaluated progressively as it matures and accumulates further real world data to provide appropriate development, validation, and refinement into the future.

Support for the star-rating concept

336. Stakeholders consulted during the course of the inquest provided, in principle, support for the concept of a star rating system for quad bikes and side by side vehicles. Safe Work Australia and WHSQ are supportive of a star rating system from a work health and safety perspective. This is because it would reflect the general requirements of work health and safety legislation to design, manufacture, supply and use safe plant, and assist each of the duty holders to meet their legal obligations. Workcover NSW and the ACCC are particularly supportive.

337. Agforce Queensland and the Queensland Farmers Federation are also supportive of any system, which enables farmers to make more informed decisions about the relative safety of vehicles they intend to use.

338. CARRS-Q is supportive but they have noted that such a system may not align with a vocal segment of the off-road riding population, which shun any form of regulation.

The industry's position to the star-rating system

339. The FCAI says that it's supportive of the star rating concept in principle but not as it is currently proposed by the UNSW TARS team. It is also supportive of ANCAP developing and administering any star rating system, but that further work is required before it would be ready to be implemented.

340. The FCAI says that a consumer safety rating system for vehicles is only valid and useful when it accurately informs consumers of the relative safety-related performance of various vehicles and is based on accident data.

341. The FCAI stresses that a potential 5-star rating system for quad bikes and side by side vehicles should include only those performance indices from tests that have been found to exhibit a strong correlation between:

- The respective performance index values for the vehicles tested; and

- The corresponding 'fatal accidents per quad bike and side by side vehicle in use in Australia' for the same vehicles.

342. The FCAI says that if no such strong correlation is demonstrated, then any purported rating based on using such performance indices cannot be valid, and should not be implemented. Further, it states there could be unintended adverse outcomes that might inadvertently infect the system by either creating or exacerbating a different type of injury or injury mechanism in actual use.

343. The FCAI argues there is very little (if any) information that has been identified within the crash data by the UNSW TARS team, which, in turn, identifies any vehicle characteristics, that would allow meaningful differentiation between vehicles in terms of their relative safety for users. The FCAI's submissions note that it is their view that the TARS team was not appropriately qualified to have undertaken testing, research and the development of a star rating system. It says it is therefore not surprising that it has adopted passenger car principles with an apparent disregard of the operational capabilities of the vehicles in an off-road environment.

344. The FCAI is highly critical of the lateral static stability testing component of the star rating system, noting strong views by the CPSC that call into doubt the appropriateness of static stability measures as a predictor of roll over resistance. It takes a similar position with respect to its dynamic handling tests and the view that star points should be awarded for understeer characteristics, and says any assumptions made that they may lead to a safer outcome, is unsupported by any reliable evidence. It was also highly critical of the testing conducted on asphalt, which does not have relevance to an off-road environment, as well as the bump test and crashworthiness testing.

345. The FCAI says that if no such strong correlation with quad bike and side by side accident data is identified in the quad bike performance project crash data, then it should be acknowledged that:

- The required data is not available to support the required correlations for an 'ANCAP type rating system';

- The currently planned quad bike rating system will be based only upon the opinion of the UNSW TARS project staff members; and

- Other experts in the field do not necessarily agree with those opinions.

346. The FCAI is concerned that the current proposed star rating system compares quad bikes to side by side vehicles, to the disadvantage of quad bikes, and compares different makes and models within the quad bike category, where in fact they are designed for different purposes and the protective measures of the vehicles are very different. It noted the TARS team had sought to apply occupant protection principles relevant to passenger cars, to quad bikes. It was also concerned about the arbitrary nature of the proposed system.

347. The FCAI says that it is important that such a rating system does not risk pushing quad bike design in the wrong direction by misunderstanding the intended and unintended consequences of design change. It would be

undesirable to 'rate' inaccurately a given vehicle (based on false assumptions in the criteria and/or opinions of the raters) when that vehicle may in fact have a very good safety record based on actual incident data (if it were available). The FCAI submitted whilst it may be tempting to propose or demand simplistic modifications to quad bike design, which may be beneficial in one particular hypothetical scenario, it is important to understand the potential unintended consequences of that modification in either creating or exacerbating a different type of incident or injury mechanism in an actual use.

348. Professor Grzebieta explained in oral evidence that the system is not designed to purposely disadvantage any makes or models, or quad bikes as compared to side by side vehicles. The same roll over safety criteria are applied across the board. The criteria does not focus on specific vehicle design and they do not see it as the role of the star rating system to dictate to manufacturers what specific engineering changes should be made to increase safety. The star rating system focuses on measurable factors that are considered to reduce the chances of roll over, such as static and dynamic stability testing. How manufacturers choose to achieve safer results is a matter for them. Professor Grzebieta explained that to separate the different makes and models and vehicle types for the purposes of rating them, would defeat the purpose of assisting consumers to choose a vehicle that is 'fit for purpose'.

Comments on issue 10

349. The star rating system concept is supported by the majority of stakeholders. More work needs to be done before it can be properly implemented. The work performed by TARS has been a good start. There may be some limitations to the testing conducted to date but ultimately any star rating system is likely to assist in choosing vehicles that are 'fit for purpose' from a safety perspective.

350. The position of the FCAI is to support the move although it rejects the TARS concept, the methodology of its testing and suggests any system needs to be evidence based to a strong correlation with data demonstrating improved safety systems. There is of course some difficulty in this regard as there are limited injury and fatality data in respect to quad bike and SSV accidents.

351. The position of TARS is that to wait in the hope that data becomes available will result in delays approaching decades, and in the meantime fatalities and injuries will continue to occur. It would also seek to rely on general physics and engineering principles, and that, in my view is entirely appropriate.

Recommendation 12

It is recommended that Safe Work Australia, and each of the State and Territory Work Health and Safety Authorities:

a) contribute to the development of a quad bike and side by side vehicle star rating program, given that the program is focussed predominantly on reducing serious injuries and deaths in the workplace.

b) The University of New South Wales Transport and Road Safety Research team's proposed quad bike and side by side star rating program should be considered as a good start for consideration of the program so long as it is ensured that it is evidence based (in consultation with the industry).

Recommendation 13

It is recommended that the Australasian New Car Assessment Program:

a) further develop and administer the star rating system once it has been established.

Improving investigations and safety research for the future

Issue 11: Whether a standardised police investigation template for quad bike fatalities should be introduced; and

Issue 12: Whether police investigator training can be improved to cover specific issues arising in quad bike fatalities.

352. The inquest heard how the difficulties in determining accident scenarios and other data impacts on some of the quality and validity of research and testing that has been conducted. Better police investigation and reporting of quad bike and side by side accidents will assist in advancing industry and government safety initiatives in the future.

353. Quad bike and SSV related fatalities often occur in remote areas, with no witnesses, and the first response police investigating officers who attend the scenes may have limited forensic vehicle investigation training and/or may be unfamiliar with quad bike and SSV specific issues.

354. Counsel assisting identified a number of important pieces of information, which would be desirable to record. They include, where possible:

- type of terrain and topography;
- weather and visibility conditions;
- turning angles;
- slope gradients;
- whether certain objects caused the loss of control;
- whether (and where) tyres lifted off the ground;
- the number of quarter rolls in the event of a roll over;
- speed (which can often be determined in the newer vehicles by consulting the electronic control panel);
- the year, make and model of the vehicle involved;
- serviceability of the vehicle (including taking tyre pressures at the scene);
- the steering configuration of the vehicle, locked or unlocked differential; and whether the vehicle was in 4WD or some other mode;

- whether a crush protection device or roll over protection system was fitted, and if so, whether it contributed to the death;
- whether seatbelts were worn, if fitted;
- age, weight and general health of the driver;
- whether a half helmet or full faced helmet was worn;
- whether the driver was intoxicated;
- if passengers were carried on vehicles designed for single operators; and
- the level of experience of the driver and whether they have completed formal training, viewed the safety DVD, or read the Owner Manual.

355. The Queensland Police Service (QPS) officers who provided evidence indicated they are supportive of establishing a standardised quad bike and SSV investigation template, to supplement existing reporting to the Coroner. To their credit, the QPS Forensic Crash Unit has been proactive in this respect and has been trialling an initial template since the beginning of this coronial investigation.

356. The QPS also indicated that they could easily add a quad bike and SSV specific component to their existing investigation training regime. I understand this has been in the process of development.

357. The FCAI and UNSW TARS witnesses indicated a willingness to assist the QPS in that endeavour. The FCAI has drafted a form for consideration. WHSQ also have a standard template for their quad bike and SSV workplace incident investigations.

358. Neither of these two initiatives would have any significant resource implications.

Hospital injury data

359. What was not discussed at the inquest in any great detail was whether there could be further work on the issue of better injury reporting from hospitals in relation to quad bike and side by side vehicle accidents. The Queensland Injury Surveillance Unit is largely responsible for some of this work in Queensland and I am aware of their own papers on quad bike injuries and deaths as well as other injury and death scenarios. I will refer my decision to it for consideration of the matter, but accept from my own experience of engagement in this area that: the gathering of such data is a complex one and to be useful, the data should be uniform and collected across the states and territories.

Recommendation 14

It is recommended that the Queensland Police Service:

a) introduce a standardised investigation template for all quad bike and side by side vehicle related fatalities, to supplement existing reporting to the Coroner. This should be developed through consultation with the Federal Chamber of Automotive Industries, the University of New South Wales Transport and Road Safety Research team and the Office of State Coroner;

b) improve investigator training to cover specific issues arising in quad bike and side by side vehicle fatalities. This should be achieved by adding a module to the existing training regime in consultation with the FCAI and the UNSW TARS team; and

c) consult with all other State and Territory Police Services in an effort to encourage them to implement the same initiatives, so that a national approach is taken.

Recommendation 15

It is recommended that all State and Territory Police Services:

a) consider implementing the Queensland Police Service standardised investigation template and improved investigation training for quad bike and side by side vehicle fatalities, once completed.

I close the inquest.

John Lock
Deputy State Coroner
Brisbane
3 August 2015

List of recommendations

Recommendation 1

It is recommended that Safe Work Australia, the Federal Chamber of Automotive Industries, and the Australian Quad Distributors Association:

a) work with AgriFood Skills Australia to develop an improved and standardised quad bike and side by side vehicle nationally accredited training package.

b) It is suggested that the starting point would be to adopt the 'off the shelf' Speciality Vehicle Institute of America's training packages already in existence, with additional components that focus on particular work environments in Australia.

Recommendation 2

It is recommended that once an improved nationally accredited quad bike training package is developed, the Queensland government:

a) introduce legislation to mandate the completion of the nationally accredited training by all quad bike riders and side by side vehicle drivers, through a certification or licensing scheme.

b) the scheme should investigate whether it is appropriate to provide some more limited standard of training for casual users, for example, in quad bike tourism operations operating in a controlled environment.

c) subsidise the training, including subsidising Registered Training Organisations, to provide the training to remote areas in Queensland to decrease participation barriers; and

d) launch an ongoing public awareness campaign about the importance of quad bike and side by side vehicle training in reducing serious injury and deaths.

e) It is suggested that the Speciality Vehicle Institute of America's model legislation be considered as a starting point for the legislative regime.

Recommendation 3

It is recommended that Safe Work Australia, the Federal Chamber of Automotive Industries and the Australian Quad Distributors Association:

a) initiate the process of introducing an Australian Standard for quad bike specific helmets to meet the needs of the agricultural community.

b) It is suggested that the New Zealand standard entitled 'All-Terrain Vehicle Helmets' (NZS 8600:2002) be considered for adoption after further investigation is completed as to its appropriateness. The standard should provide that competitive recreational riders and road users must still wear helmets that comply with the Australian Standard for motorcycle helmets (AS 1698), or other similar international Standards.

Recommendation 4

It is recommended that the Queensland government:

a) Direct the Queensland Department of Transport of Main Roads to amend their 'Guideline' relating to conditional registration for quad bike and side by side vehicle operation on roads and road related areas, to include mandatory helmet use. For road usage, helmets should comply with the Australian Standard for motorcycle helmets (AS 1698) or other similar international standards.

b) Once an Australian Standard for quad bike specific helmets is implemented, it is recommended that the Queensland government:

   i. introduce legislation to mandate the wearing of helmets (which comply with the Australian standard) by all quad bike and side by side vehicle operators in Queensland; and

   ii. launch an ongoing public awareness campaign about the importance of wearing helmets on quad bikes and side by side vehicles in preventing death and serious injury.

   iii. It is suggested that the Specialty Vehicle Institute of America's model helmet legislation be considered as a starting point for the legislative regime.

Recommendation 5

Noting that children between 6 – 16 are permitted to operate 'youth sized' quad bikes and side by side vehicles, according to the manufacturer's age recommendation for a particular vehicle, it is recommended that the Queensland government introduce legislation to:

a) prohibit children under the age of 16 from operating adult sized quad bikes and side by side vehicles;

b) prohibit children between the ages of 6 and 16 from operating a youth sized quad bike or side by side vehicle, that is not specified to be appropriate according to the manufacturer's age recommendation for that particular vehicle;

c) prohibit children under the age of 7 from being carried as passengers on adult-sized side by side vehicles, as well as any child of whatever age if they are unable to sit with their back against the seat, feet flat on the floor and floor rests, and hands on handholds; and

d) prohibit children under the age of 16 from being carried as passengers on adult-sized sit-astride quad bikes.

e) It is suggested that the Specialty Vehicle Institute of America's age based model legislation be considered as a starting point for the legislative regime.

f) It is recommended that the Queensland government support the introduction of the legislation with an ongoing public awareness campaign about the dangers

of parents and guardians allowing children to ride adult sized vehicles and 'youth sized' vehicles that are inappropriate for the age of the relevant child.

Recommendation 6

It is recommended that the Queensland government:

a) introduce legislation to prohibit carriage of passengers on quad bikes other than those specifically designed to carry an operator and a passenger; and

b) launch an ongoing public awareness campaign about the importance of only carrying passengers on quad bikes and side by side vehicles that are designed to carry a passenger (to reduce the chance of loss of control and roll over) and to highlight the importance of carrying age appropriate passengers in accordance with the manufacturer's recommendations on vehicles that are designed to do so.

c) It is suggested that the Specialty Vehicle Institute of America's age based model legislation be considered as a starting point for the legislative regime.

Recommendation 7

It is recommended that Safe Work Australia:

a) manage or oversee the development of an Australian Standard, or the like, for crush protection devices fitted on sit-astride quad bikes in Australian workplaces.

Recommendation 8

It is recommended that Safe Work Australia and the manufacturers of the Quadbar and Lifeguard:

a) fund an independent survey study of all persons who currently use the Quadbar and Lifeguard crush protection devices to obtain 'real world' feedback regarding their effectiveness. (The study could also potentially be expanded to consider the estimated 10% of the New Zealand quad bike population who are believed to be utilising crush protection devices); and

b) develop guidance for workplaces to assist them in conducting a more informed risk assessment as to whether a crush protection device is appropriate for their situation.

Recommendation 9

It is recommended that the manufacturers of the Quadbar and Lifeguard crush protection devices:

a) provide their customers with written guidance about what to do in the event of a roll over where their crush protection device is fitted.

Recommendation 10

It is recommended that the Federal Chamber of Automotive Industries and the Australian Quad Distributors Association:

a) initiate the process of developing an Australian Standard through Standards Australia, in consultation with relevant stakeholders, for the design, manufacture, import and supply of quad bikes and side by side vehicles to Australia.

b) It is suggested that the Australian Standard should be based on the US Standard.

Recommendation 11

It is recommended that Safe Work Australia:

a) consider whether a different safety standard is required for workplace and on-road quad bikes. If so, it is recommended that Safe Work Australia initiate the process of either an Australian Standard, or a Vehicle Standards Bulletin, in consultation with the industry and other relevant stakeholders.

Recommendation 12

It is recommended that Safe Work Australia, and each of the State and Territory Work Health and Safety Authorities:

a) contribute to the development of a quad bike and side by side vehicle star rating program, given that the program is focussed predominantly on reducing serious injuries and deaths in the workplace.

b) The University of New South Wales Transport and Road Safety Research team's proposed quad bike and side by side star rating program should be considered as a good start for consideration of the program so long as it is ensured that it is evidence based (in consultation with the industry).

Recommendation 13

It is recommended that the Australasian New Car Assessment Program:

a) further develop and administer the star rating system once it has been established.

Recommendation 14

It is recommended that the Queensland Police Service:

a) introduce a standardised investigation template for all quad bike and side by side vehicle related fatalities, to supplement existing reporting to the Coroner. This should be developed through consultation with the Federal Chamber of

Automotive Industries, the University of New South Wales Transport and Road Safety Research team and the Office of State Coroner;

b) improve investigator training to cover specific issues arising in quad bike and side by side vehicle fatalities. This should be achieved by adding a module to the existing training regime in consultation with the FCAI and the UNSW TARS team; and

c) consult with all other State and Territory Police Services in an effort to encourage them to implement the same initiatives, so that a national approach is taken.

Recommendation 15

It is recommended that all State and Territory Police Services:

a) consider implementing the Queensland Police Service standardised investigation template and improved investigation training for quad bike and side by side vehicle fatalities, once completed.

EXHIBITS LIST

INQUEST: Quad Bike Phase 2

NO.	DOCUMENTS
A	**ACCC - Australian Competition and Consumer Commission**
A1	Letter from Neville Matthew
A1.1	Response from ACCC
B	**Safe Work Australia**
B1	Letter from Drew Wagner - SWA Response for Form 25
B1.1	Letter from Drew Wagner
B2	Letter to Qld Coroner KND McIntosh Reports
B2.1	McIntosh Quad Bike CPD Specification Part 1 CPD Specifications
B2.2	McIntosh Quad Bike CPD Specification Part 2 Draft CPD Guidelines
B2.3	KND Quad Bike Design Standards Part 1 Discussion and Justification
B2.4	KND Quad Bike Design Standards Part 1 Annex A Bump Obstacle Test
B2.5	KND Quad Bike Design Standards Part 1 Annex B Brake Performance Test
B2.6	KND Quad Bike Design Standards Part 1 Annex C Dynamic Handling Requirements
B2.7	KND Quad Bike Design Standards Part 1 Annex D Stability Test Data
B 2.8	KND Quad Bike Design Standards Part 2 Draft Australian Safety Requirements and Test Methods (ASRTM) for Quad Bikes
B2.9	KND Quad Bike Design Standards Part 2 DRAFT ASRTM Annex A Service Brake Performance Test
B2.10	KND Quad Bike Design Standards Part 2 DRAFT ASRTM Annex B Parking Brake Mechanism Test Procedure
B 2.11	KND Quad Bike Design Standards Part 2 DRAFT ASRTM Annex C Dynamic Handling Test Procedure
B2.12	Quad Bike Design Standards part 2 DRAFT ASRTM Annex D Bump Response Test Procedure
B2.13	KND Quad Bike Design Standards Part 2 DRAFT ASRTM Anne E Stability Test Procedure
B2.14	KND Quad Bike Design Standards Part 2 DRAFT ASRTM Annex F Safety Requirements Verification and Test Method
B2.15	KND Quad Bike Design Standards Part 2 DRAFT ASRTM Annex G Rider Competency Evaluation Check List
C	Standards Australia Limited
C1	Letter from Fiona Bustos-McNeil
C2	Statement of Adrian Gerard O'Connell
C2.1	Exhibit AOC 1 Standardisation Guide 001 Preparing Standards
C2.2	Exhibit AOC 2 Project Prioritisation Process and Criteria

C2.3	Exhibit AOC 3 Proposal Form Standards Developments Projects
C2.4	New Zealand All Terrain Vehicle Helmets NZS 8600:2002
D	**CARRS Q QUT Centre for Accident Research & Road Safety**
D1	CARRS-Q Response to Form 25
E	**UNSW Transport and Road Safety (TARS) Research**
E1	Response to Form 25 Prof Raphael Grzebieta
E1.1	Rechnitzer G, Day L, Zou R & Richardson (2003) All Terrain Vehicle Injuries and Deaths, Monash University Accident Research Centre
E1.2	Quad Bike Performance Project Reference Group Members
E1.3	Copy of Paper Reducing All-Terrain Vehicle (ATVs) Injuries and Deaths - A way Ahead
E1.4	Biographies of Expert Witnesses Recommended
E2	Quad Bike Project Final Report Static Stability Test Results
E2.1	Quad Bike Project Final Report Dynamic Handling Test Results
E2.2	Quad Bike Project Final Report Crashworthiness Test Results
E2.3	Final Summary Report Test Results, Conclusions and Recommendations
E2.4	Supplemental Report Exam and Analysis Fatals and Injuries
E2.5	Appendix B Instrument Response Data
E2.6	Appendix C Test response data
E2.7	Appendix D Test Response data
E3	QuadBike Paper Grzebieta 2014
E3.1	Investigtion of Zellner et al 113 Case Simulations
E3.2	Supplementary Report Zellner 20041022
E3.3	Quadbar MonashReport noCV
E4	Capture and surveillance of quad bike (ATV) related injuries in administrative data collections Mitchell et al
E5	Curriculum Vitae Prof. Raphael Grzebieta
E6	Bio of Keith Simmons
E7	Powerpoint presentation Dr Raphael Grzebieta
E8	Dr R Grzebieta QB Injuries Per annum (2015) document
E9	Email lfrom Keith Simmons Re: Vehicle Standards Bulletins
F	**FCAI - Federal Chamber of Automotive Industries**
F1	Letter from Peter Cash Norton Rose Fulbright
F1.1	Annexure to FCAI Response to Form 25 Vol 1
F1.2	Annexure to FCAI Response to Form 25 Vol 2
F2	DVD Video 'You and Your ATV'
F3	Images and Footage from ATV Demonstration 15.07.2014
F4	Australian/New Zealand Standard Protective helmets for vehicle users

F5	Curriculum Vitae Terrance A Smith Ph.D.
F6	Curriculum Vitae Associate Professor Robert Anderson
F6.1	Current Curriculum Vitae Associate Professor Robert Anderson
F7	Curriculum Vitae Graeme F Fowler Ph.D., P.E.
F7.1	SAE International Recreational Off-Highway Vehicle (ROV) Handling and Control 2012-01-0239
F8	Updated injury risk-benefit analysis of Quadbar crush protection device
F9	2014 Van Ee et al ATV Rollover Video Analysis
F9.1	Van Ee supplementary report (24917146_1)
F9.1.1	Power Point Presentation - Dr C Van Ee
F10	T Smith Helmets Power Point Presentation
F10.1	Synopsis Report Dr Terry Smith
F10.2	T Smith AIS Coding
F11	Expert Opinion Associate Professor Robert Anderson
F12	Quad Bike Supplemental Traffic Crash Report Form
F13	DRI Review of Papers by Richardson et al
F13.1	DRI Review of Papers by Richardson et al DRI-TR -14-01
F13.2	DRI Comments on Monash/ISCRR Report by Wordley (2012) DRI-TR-14-12
F14	Copy of Helmet Standard Spreadsheets November 2014
F15	Briefing Package on All-Terrain Vehicles
F16	SAE - Transient Analysis of All Terrain Vehicle Lateral Directional Handing & Stability
F17	Lateral Stability Status Report
F18	Measurement of rider active effects on ATV performance DRI-TR-1- 04 2014-2-19
F19	WHO Helmet Manual
F20	MCHI 2011 GHVI Helmet Standard
F21	Vietnam motorcycle helmet standard
F22	Report All-Terrain Vehicle Handling and Control
F22.1	Professional Profile- Graeme F Fowler Ph.D., P.E.
F23	DRI Full-Scale Dynamic Overturn Tests of an ATV with and without a Quadbar CPD using an injury-monitoring dummy
F23.1	DRI Supplemental Injury Risk Benefit Analysis QuadBar CPD for ATVs
F24	SVIA Model State All-Terrain Vehicle Legislation
F25	Renfroe -SAE International- Reconciliation of ATV/UTV Handling Characteristics and the Operator
F26	Power Point Presentation - J Zellner
F27	DVD QB/ATV Tests - Dr G Fowler

F28	USB Drive QB/ATVTests - John Zellner
F29	2013 Annual Report of ATV related deaths and Injuries
F30	Health and Safety - Use of All Terrain Vehicles in the Workplace
F31	Review of RG 1 page injury analysis with a Quad Bar
F32	The New Car Assessment Program: Five Star Rating System and Vehicle Safety Performance Characteristics
F33	Evolution of Australian NCAP Results Presentation Paper No. 98-S11-0-04
F34	Australian New Car Assessment Program Paper No. 94 S8 0 14
G	**MUARC - Monash University Accident Research Centre**
G1	Response to Form 25 Prof Lesley Day
G1.1	Quad Bike Safety Devices : Summary of an Evidence Review
G1.2	Motorcycle deployment and rider characteristics on Victorian Farms
H	**University of Sydney Aust Centre for Ag Health and Safety**
H1	Submission Inquest into Quad Bike Related Deaths A/Prof Tony Lower
H1.1	Lower and Trotter 2014 Adoption of Quad Bike Crush Prevention Devices on Australian Dairy Farms
H1.2	Clapperton et al 2013 Quad bike -related injury in Victoria Australia
H1.3	Lower et al 2013 Australian quad bike fatalities: what economic cost
H1.4	Lower 2013 Editorial Quad bikes: tobacco on four wheels
H1.5	Lower 2012 Policy and Practice
H1.6	Lower et al 2012 Quad bike deaths in Australia 2001 to 2010
H1.7	Lower 2011 Perspectives Reducing farm injury deaths through regulation
H1.8	Lower et al 2011 Potential for preventing farm fatalities in Australia
H2	Why Quad Bike Safety is such a Wicked Problem
H3	Prevention of bicycle -related injuries in children and youth: a systematic review of bicycle skills and training interventions
H4	CPSC special report ATV related deaths and injuries May 2014
H5	Supplementary submission from Associate Professor Tony Lower
H6	Copy of Statement of Commissioner Robert S Adler
H7	CPSC In Depth Investigations OMB (25)
H8	ISCRR Quad Bike Crush Protection Devices (CODs): Updates to ISCRR Snapshot Review C-1-12-022
H9	Pediatrics Official Journal of the American Academy of Pediatrics - Aged based risk factors for Pediatric ATV- Related Fatalities
H10	Tony Lower CV 2014
H11	Child and youth mortality from motorcycle, quad bike and motorised agricultural vehicle use with a focus on deaths under age 15 years
I	**Queensland Police Service**
I1	Letter from Deputy Commissioner S W Gollschewski
I1.1	What to note during Quad Bike and Side by Side crash investigation
I 2	Letter from Sergeant Simon Lamerton
I2.1	PT51 Qprime Form

I3	Letter from Sergeant Nicole Fox
!4	Statement of Simon Robert Lamerton
J	**Office of Fair and Safe Work Queensland**
J1	Response to Form 25
J1.1	Quad Bike Options Paper final 181208
J1.2	Quad Bike Crush Protection Device Pilot Report
J1.3	HWSA TEG REPORT
J1.4	RIAP4 Quad Bikes Summary Report
J1.5	QBWG BROAD INDUSTRY STRATEGY
J1.6	Safety Alert Quad Bikes
J1.7	Rural Plant Code of Practice
J1.8	USQ An assessment of passive roll over protection for Quad Bikes C Snook
J1.9	Quad Bike Safety Devices : A Snapshot Review (3 Pages)
J1.10	Quad Bike Safety Devices : A Snapshot Review (Final)
J1.11	Quad Bike Safety Devices: A Snapshot Review (One Page Summary)
J1.12	Safe Work Method Statement
J2	WHSQ response for Coroner Lock - Quad Bike Inquest
K	**Queensland Farmers Federation**
K1	Letter from Dan Galligan and Submission to Coroner
L	**Office of Fair Trading**
L1	Letter from David Ford
M	**Commission for Children and Young People and Child Guardian**
M1	Letter from Mr Steve Armitage
M1.1	Letter from Mr Steve Armitage
N	**Ag Tech Industries**
N1	Certified and audited tests carried out on ATV Lifeguard
N2	Email from Aedan Bryan to VT Suckling
N3	Email from Matthew Tiplady
N3.1	Simulation and Analysis of Quad Bike Rollovers using PC-CRASH to Evaluate Alternative Safety Systems
O	**QB INDUSTRIES**
O1	Quadbar Submissions David Robertson
O1.1	Dynamic Research - The Robertson V-Bar ROPS Technical Report
O1.2	Ridge Solutions Technical Report
O1.3	Press Release- Real Life Data Proves Quad Bars have saved many people from trauma
O1.4	Analysis of Design Research Engineering Presentation to CPSC
O1.5	Mount Isa Statement on Quad Bike Safety 2012 - Media Release

O1.6	Col Finnie Submission on Quad Bike Safety Issue
O1.7	Trans -Tasman Industry Solutions Program Working party Quad Bikes (ATVs) Agricultural Industry
O1.8	TV Coronial Inquiry - Reply Distributors Submission (1) (2)
O1.9	QB029 FCAI Submission to Work Safe Australia Public Discussion Paper: Review of Design and Engineering Controls for Improving Qu
O1.10	Monash University ISCRR Quad Bike Safety Devices : A Snapshot review
O1.11	Letter from David Robertson
P	**Qld Department of Transport and Main Roads**
P1	Letter from Teresa Moore DTMR
P1.1	Guideline for Conditionally Registered Vehicles
Q	**Polaris Industries Australia and New Zealand**
Q1	Letter from Philippa Baker (Baker McKenzie)
Q1.1	2014 Polaris Sportsman ACE Sell Sheet
Q1.2	Media Release - Polaris introduces revolutionary new Off-Road Vehicle
Q1.3	Publication - Sportsman ACE Engineered Parts, Accessory & Apparel
Q1.4	Publication - Polaris 15 models with R.O.P.S. Roll Over Protection Structure
Q1.5	Publication Polaris "Hardest Working. Smoothest Riding"
Q1.6	Power farming Magazine Polaris ACE full page publication
Q1.7	Commando News - Polaris Sportsman ACE half page publication
Q1.8	Screen shots from www.polaris.com of the Polaris Sportsman ACE
Q1.9	American national Standard for Recreational Off Highway Vehicles -ANSI/ROHVA 1 - 2011
Q1.9.1	Revised American National Standard for Recreational Off Highway Vehicles -ANSI/ROHVA 1 - 2014
Q1.10	Disk containing Promotional video describing Polaris Sportsman ACE on farm 2015
Q1.11	Disk containing Video describing Polaris Sportsman ACE Safety Information and video describing features of Polaris ACE
Q2	Statement of Scott Taylor
R	**Geoff McDonald and Associates Pty Ltd**
R1	Overview of Dynamic Research, INC.'S two assess Robertson Q Bar
R1.1	Appendices Vol 1
R1.2	Curriculum Vitae Geoffrey Lloyd McDonald
R1.3	Overview of Dynamic Research Vol II
R1.4	Overview of Dynamic Research Inc -Two assessments of the Robertson Quadbar
R1.5	Overview of Dynamic Research Vol III
S	**Extreme Motorcycles, Quad Safe Australia, Extreme Quad Adventures**
S1	Submission Inquest into Quad Related Deaths - Colin Lawson
S1.1	Event Plan for ORVcard
S1.2	Introduction Letter ORVcard
T	**Motor Cycling Australia Quad Commission**

T1	Email from Darrell Knight
T1.1	Submission from Darrell Knight
T2	Submission from Darrell Knight
U	**National Coronial Information Services**
U1	NCIS Report
U1.1	Attachment 1+B143
U1.1.1	Amended NCIS Report
V	Department of Infrastructure and Regional Development
V1	Email from David Stephens, Director MVSA Review Projects
W	**Delta -V-Experts**
W1	Report Dr Shane Richardson
W1.1	2014 October FarmSafe
X	**Queensland Tourism Industry Council**
X1	QTIC Briefing Note
X1.1	Photograph 1
X1.2	Photograph 2
X1.3	Photograph 3
X2	Email from Trevor Hassard and QT Web Page
Y	**FN Quadriders Club**
Y1	RTO1 Off Highway
Y1.1	MCSA Review ULATV Submission
Z	**Australian Quad Distributors Association**
Z1	Email from Ken Higgins
Z1.1	AQDA Response to Queensland Coroner's Inquest issues
Z1.1.1	Email from Ken Higgins
AA	**AgriFood Skills Australia**
AA1	Email Chain OSC request for information AgriFood Skills Australia
AA1.1	Response to Coronial Recommendations
AB	**AgForce Queensland Industrial Union of Employers**
AB1	Letter from Ian Burnett