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Quad Bike Safety Devices: Summary of an Evidence Review

Background

There has been growing concern about the numbers of injuries and deaths occurring as a result of the use of all-terrain vehicles (ATVs) or 'Quad bikes'. Safety regulators, agricultural and transport research institutes, farming associations, state coroners and vehicle distributors have all expressed opinions on how to improve the safety of Quad bike users.

Purpose

This literature review critically assessed research relating to the efficacy of a crush protection device which can be fitted to Quad bikes, called the 'Quad Bar'.

Method

Twenty reference items were reviewed, including two that reported statistical data on Quad bike injuries and deaths, four that presented experimental data on roll or crush protection devices, five that presented simulation data for protection devices and one item that presented both experimental and simulation results. Four additional publications were primarily critiques of some of these items. Four references present various position statements on the adoption of CPDs.

Research findings

It was found that:

- Quad bikes were the leading cause of death on Australian farms in 2011, accounting for around one-third of fatalities. These deaths commonly resulted from chest, head or spinal injuries. Children under 14 years and older people over 45 years were the most common victims;
- Various simulation programs (including MADYMO, ATB and MATD) were adapted and used by researchers to model Quad bike accident scenarios. A large number of shortcomings were identified with these models. Most importantly, none of the models were able to predict asphyxiation fatalities which accounted for 40% of Australian Quad bike roll over deaths;
- The computer simulations were loosely based on Quad bike incident descriptions provided by the UK Health and Safety Executive and the US Consumer Product Safety Committee. In general, these incident descriptions were extremely brief and contained insufficient information to accurately define the accident scenarios;
- Many assumptions and interpretations were made by the researchers attempting to simulate these scenarios, most of which had the potential to significantly alter the simulation results. A clear and agreed interpretation of data by researchers and a defined test methodology is required in order to minimise variations in findings by researchers.
- Several issues were identified with the methods used to model the different terrains, particularly the ground stiffness and friction coefficients chosen, and the extreme length of the slopes commonly modelled. These factors appear to have generated roll dynamics and injury outcomes which are potentially inaccurate;
- The Dynamic Research Inc. (DRI) research in particular caused a substantial and unexplained shift in the nature of the injuries predicted, dramatically over-predicting head injuries and virtually eliminating chest injuries. This shift in the nature of injuries predicted

by the simulations removed much of the potential for crush protection devices tested to reduce the simulated rider injuries;

- The method described by ISO 13232 for calculating risk benefit ratios was found to be extremely susceptible to influences from a range of factors including: the test scenarios chosen, the inherent variability in each case, and the methods used to compare minor, non-permanent injuries with fatalities;
- Experimental tests conducted by the University of Southern Queensland indicate that the Quad Bar CPD is capable of either preventing a complete roll, or modifying the roll event to reduce the risk and severity of injury to the rider for both side roll and back flip scenarios. These results highlight the potential for CPDs such as the Quad Bar to reduce rider injuries and fatalities resulting from low speed roll over incidents;
- The Federal Chamber of Automotive Industries (FCAI) is an industry body which represents the major importers and distributors of Quad bikes within Australia, including Suzuki, Honda, Yamaha, Kawasaki, Polaris and Bombardier. The FCAI's strong opposition to the fitment of CPDs in general and the Quad Bar in particular was found to be based on the research produced by Failure Analysis Associates and DRI. Their reasons for rejecting such devices cannot be supported given the major problems with the research methodologies identified by this review.

Research conclusions

This review identified serious issues with the simulation methods used and the nature of incidents tested to predict the effect of crush protection devices on Quad bike roll over injuries and fatalities. Limited experimental and simulation results indicate that the Quad Bar crush protection device demonstrates potential to reduce injuries and fatalities, particularly those arising from low speed lateral roll and back flip events.

It is recommended that:

- A working group containing representatives from the major stakeholders in this issue be formed and asked to plan out and agree on the nature and specification of future research activities before they are undertaken.
- A new incident dataset be developed based on Australian and perhaps New Zealand Quad bike fatality reports. This dataset should be used for future simulations into the effectiveness of crush protection devices.
- A preliminary standard be proposed for the design and specification of Quad bike CPDs, perhaps based upon the existing New Zealand guidelines, or those for Tractor ROPS.
- Funding is sourced from government or OH&S regulatory bodies for additional research into Quad bike crush protection devices.
- The research is undertaken in Australia by researchers with expertise in this field.
- Any proposed working group consider conducting the following new research:

Experiments:

Basic Quad bike lateral roll, forward flip and back flip tests for a range of speeds and slope angles should be conducted using an instrumented dummy. The 'Vehicle Accelerator' developed by The University of Southern Queensland could be utilised for these tests. Such tests should confirm and quantify the level of injury protection provided by CPDs such as the Quad Bar, for these incident types.

Simulations:

Computer simulations should be used to accurately correlate the experimental tests, on the basis of both dummy and bike motions, and recorded injuries. Providing adequate correlation can be achieved, these simulations can be extended to incorporate additional generic overturn events (which are more difficult to reproduce

experimentally) and the proposed new injury dataset containing Australian fatality scenarios.

In-the-field data gathering:

Fit a large sample (>100) of Quad bikes currently being used by farmers with light weight and inexpensive devices which are capable of recording video, accelerations, speed and map position of the bike whilst it is being used in the field. Data gathered from this study would provide insight into the operational characteristics of Quad bikes, and quite likely some examples of loss of control and roll over events. It is acknowledged that some proportion of this sample population will include bikes fitted with CPDs which would provide useful additional data as to the effectiveness of such devices.

A table summarizing limitations identified in the existing research is included in the Executive Summary of the full report.

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