



HUMAN FACTORS & ERGONOMICS
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Human Factors and Ergonomics

Society of Australia

User-Centred Design of the Road Transport System to Reduce Road Trauma

Submission to the Joint Select Committee on Road Safety
24 August 2021



Introduction

The Human Factors and Ergonomics Society of Australia is the peak body for the human factors and ergonomics profession and represents and lobbies government and industry on issues relevant to ergonomics and human factors in Australia (see further details in the Box below). We are pleased to present this brief submission to the Parliament of Australia Joint Select Committee on Road Safety.

The submission focusses on a new and broader approach to understanding the causes of road traffic crashes. This approach acknowledges that errors by road users are not inevitable; rather they result in large part from poor usability of the road system and are the consequences of poor design of our road system. This means that, through improving road system usability, we can improve all aspects of our road system: vehicles, roads, road rules and road user education to prevent crashes and improve road safety. This new approach addresses crash prevention rather than focusing mainly on mitigating the consequences of a crash, which is the focus of most of our current road safety strategies (eg: roadside barriers, airbags, seatbelts etc); although we recognise that these mitigation strategies are nevertheless important and have demonstrated safety benefits. This submission therefore addresses all of the Terms of Reference for the inquiry as it provides a new context for action.

The submission was prepared jointly by two of our HFESA Members: Emeritus Professor Ann Williamson and Emeritus Professor Michael Regan. Both are affiliated with the University of NSW, Sydney, and both are Fellows of the Australasian College of Road Safety. This submission largely summarises the argument advanced in a recent paper published by Ann Williamson in the *Journal of Road Safety* (*Why do we make safe behaviour so hard for drivers?* Attachment 1) and in a recent press release by Michael Regan issued by the University of NSW, Sydney (Attachment 2). These attachments provide further details and examples of the benefits of the new approach to road safety suggested in this submission. Importantly, the submission builds on the central argument advanced in these documents by highlighting areas of road safety where user-centred design can be readily implemented or can be brought to a primary focus, and how.

About the Human Factors and Ergonomics Society of Australia

Ergonomics (or Human Factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance. The terms *ergonomics* and *human factors* are often used interchangeably.

The Human Factors and Ergonomics Society of Australia is the peak body for the Human Factors and Ergonomics profession in Australia. We have more than 700 members across Australia and represent people from a wide range of professional and allied disciplines including, for example, engineering, psychology, safety science and physiotherapy. Our vision is to promote people-centred environments, products and systems for all. See www.ergonomics.org.au for further information.



Our Submission

After some decades of consistently improving road safety, the quest to continue this improvement has stalled in Australia. We are now seeing only small if any reductions in fatalities and no changes in hospitalisations due to road traffic crashes. It seems that our traditional approaches to road safety of education, engineering and enforcement are no longer as effective as they were. We need a new approach.

Road user error has been largely overlooked in our current approaches to road safety. A primary principle of the much-vaunted Safe System approach to road safety for example is that road user error is inevitable. This means that road safety strategy based on these ideas has emphasised mitigating or limiting the damage to road users when an error is made by, say a driver, cyclist or pedestrian. The result of this approach is that we have fewer fatalities but have little effect on the numbers of crashes or hospitalisations because not enough crashes aren't prevented. This approach is clearly limited in scope, but in our view, the fundamental problem with it is that it ignores the fact that many of the errors made by road users are the consequence of poor design and usability of the road system. Drivers for example, who can't see the speed sign due to its location or visual clutter around it or can't read a navigation sign quickly enough due to the complexity of the information it contains will not respond as road designers expect. In these circumstances crashes that occur because the driver was speeding above the limit they failed to see or who quickly take an unsafe manoeuvre, so they do not miss their turnoff, are not due to driver error. Rather these crashes are due to poorly designed signs. Fix the signs and error will reduce.

Human Error Through Poor Road System Design

The Human Factors and Ergonomics community in Australia, and internationally, has, for many years, advocated for the road system to be designed from a user-centred perspective - to ensure that the capabilities and limitations of road users are accounted for. Unfortunately, this perspective has to-date not been adopted in Australia to the extent that it could be. When we conceptualise human error as inevitable, as we have done in road safety in Australia, and we focus on passive mitigation of the consequences of those errors when they occur, we ignore the fact that many road user errors are induced by poor ergonomic design of the road system – of vehicles, roads, traffic management devices and speed limits. Worst of all, we miss chances to reduce those errors and any crashes that result.

Integrating Human Factors into the Road System Design: A way forward

We need to develop more formal processes for ensuring that vehicles, roads and the traffic management system are designed from a user-centred perspective to reduce and prevent human error and, in doing so, reduce road trauma. This is a big job and there are multiple opportunities for doing so. The long-term aim should be to ensure user-centred design and usability are factored into all aspects of road safety. In the short-term, however, there are some areas of road safety where user-centred design can be readily implemented or can be brought to a primary focus. The remainder of this submission describes where and how this can be done.

1. Formalising human factors integration into safe road system design

Good ergonomic, user-centred, design needs to be firmly embedded within any mode in the transport system. Furthermore, human factors principles and requirements are relevant to all stages in the lifecycle of the various elements (eg., vehicles, roads and traffic management devices) of a transport system. These stages include: concept design; product design; build/construction; testing; in-service operation; and de-commissioning. Human Factors Integration (HFI) describes the process for integrating human factors into the systems engineering process. Some transport modes in Australia have already implemented human factors integration into their accepted processes. For example, the HFI process is well known and adhered to in the rail industry (e.g. Sydney Trains) and has many benefits (RISSB, 2019, p. 10), including improved safety through the reduction of human errors, violations, and injury. Also, the rail industry experience shows that the adoption of and adherence to HFI process reduces project risk through early identification of end user issues and requirements and enhances planning to reduce the possibility of systems and assets failing to be accepted by end users. Increasingly, it is mandatory for consultants, when tendering for major engineering projects (e.g. light rail projects), to include in their tenders a "Human Factors Integration plan". Human Factors integration involves "applying a systematic and scientific approach to the



identification, tracking, and resolution of issues related to human-system interactions.” (RISSB, 2018; p. 5). These Human Factors issues are identified for all phases in the lifecycle of the system.

We need to adopt and adhere to the HFI process in designing the road transport system. By doing so, we will reduce human error, and save lives. There already exist HFI guidelines and standards that can be borrowed from the rail system (RISSB, 2018; ASA, 2018) that could be used to create and implement a HFI process in road safety.

2. Implementing user-centred design in vehicles

Some guidelines and standards for design do exist such as those developed by organisations like the International Organisation for Standardisation (ISO) for user-centred design of vehicle cockpits. Manufacturers, themselves, also produce their own, in-house, human factors design guidelines. However, adherence to these standards and guidelines by manufacturers is largely voluntary. As a result, there is enormous variation in the design and location of vehicle displays and controls and in the manner in which drivers are required to interact with them. Examples abound of poor design: pillars in vehicles that limit outside vision and create blind spots; warnings that go off that make no sense to drivers, startling and distracting them; side mirrors that show objects behind at a different distance from side mirrors, causing confusion; the absence of physical controls that force drivers to perform even basic functions (like finding a radio station) through “soft controls”, using touch screens, accessible only through multiple menus; and so on. This point is underscored in the paper by Williamson at Attachment 1.

The Australian Vehicle design rules are a potential avenue for including a user-centred design approach to vehicles allowed on our roads, however, this has traditionally been a slow process. Far more successful has been the Australian New Car Assessment Program (ANCAP) in assessing the safety of new cars entering the Australian market, encouraging competition between manufacturers to build safer cars, in establishing a star safety rating system (with 5 stars being awarded for the safest cars) and in stimulating societal demand for 5-star cars. Currently, there are no test protocols within ANCAP for assessing the design and safety of the human-machine interface through which drivers interact with the vehicle; to test, for example, what is the impact of wide A pillars on drivers vision, how drivers use existing features of their vehicle such as convex sidemirrors, or use new driver assist technologies such as Automated Emergency Braking or Lane assist and whether levels of distraction created by driver interaction with on-board infotainment and other systems is within acceptable limits. We need to implement a usability and safety evaluation star-rating program to help guide consumers on the best choices of vehicles that help them to drive more safely and stimulate societal demand on a large scale for well ergonomically designed vehicles that minimise distraction, driver workload and human error. A paper by Imberger, Poulter, Regan et al (2020), uploaded with this Submission, describes preliminary work that has been done towards the establishment of a test protocol and system for rating the distractibility of the human machine interface in new vehicles entering the Australian market.

3. Implementing user-centred design for roads

Some user-centred guidance material also already exists for applying human factors considerations to some aspects of road and traffic engineering design. Many are embedded in various Austroads and other engineering design guidelines and standards (e.g., AS 1742, 2020). However, the guidance is sporadic and does not cover the whole range of human factors that need to be considered at all stages of the lifecycle of the road and traffic management system. Consequently, it is not surprising, as everyday road users, that we regularly encounter examples of poor road and traffic engineering design: signs located too soon that trick drivers into turning off the road before they actually want to; pedestrian signals that provide no feedback to users that they are there, with waiting times so long that pedestrians cross illegally out of sheer frustration; missing signage that makes it difficult for drivers to know what road they are on, and what road they are turning onto; poorly designed signs that confuse drivers; speed limits on roads that are not perceived as credible by drivers in their context which create frustration and lack of adherence to limits; and so on.

Strategies already exist that can be reinforced and promoted to improve usability and user-centred design of roads. These include:

- i) **Road Safety Auditing** - Road safety audits have been conducted in Australia for some time. They involve the inspection and evaluation of an existing or future road, or segment of road, by an independent multidisciplinary team in order to identify safety issues and opportunities for improvements in safety. To our knowledge, current practices do not require experts in Human Factors to be part of auditing teams. We need



to formally require human factors expertise in road safety audits around Australia. This would enhance the safety of existing and new roads by ensuring that as well as being safe in terms of limiting the consequences of crashes, roads are more usable and less likely to promote error in drivers and other road users.

ii) AusRAP - The Australian Road Assessment Program (AusRAP) is a star rating scheme that has been applied to the assessment of roads and segments of roads. Star ratings are awarded based on their level of safety on a scale of 1 to 5-stars, with 1-star being least safe and 5-star being the safest. “Safe roads with design elements such as dual lane divided carriageways, good line marking and wide lanes have a higher star rating. Lower-rated roads are likely to have single-lanes and be undivided with poor line marking and hazards such as trees, poles and steep embankments close to the edge of the road.” (NRSPP, <https://www.nrspp.org.au/resources/ausrap-star-rating-australias-national-network-of-highways/>). AusRAP already includes some components consistent with user-centred design, such as an emphasis on making roads predictable for drivers. For example, having consistency between the nature of the road system and speed limits. Limits must be credible to drivers so high speed limits can be allowed on good quality divided or five star roads but where low speed limits are recommended, road design should help drivers to achieve this through devices that naturally make drivers slow down. Unfortunately, this approach to road design is not implemented often enough on Australian roads. Again, we are missing an opportunity to enhance human-centred design of roads and traffic management devices to reduce human error and enhance safety. As for ANCAP, we need to develop more formal test protocols and perhaps a rating system that focuses on human factors and ergonomic design deficiencies in road design that can be implemented to improve it.

4. Further opportunities to implementing user-centred design: road rules and road safety campaigns

The integration of human factors and ergonomics principles should also be applied to the rules for road safety and to the types of road safety campaigns that are used to attempt to promote road safety in the community. Road safety strategies rely heavily on rules that govern how road users behave. Unfortunately, many road rules are implemented with very little consideration of how road users will comply and that there may be unintended consequences of complying with the road rule. Examples of this problem are many and varied but mostly they are simply not acknowledged. For example, requiring drivers to slow down in work zones located on high-speed highways often presents problems where there is poor advance signage of the work zone. The introduction of pop-up cycleways with different rules for drivers about where they can drive and their legal speeds often cause problems of compliance when drivers do not expect them. The development of road rules needs to incorporate usability and user-centred design principles in order to make it as easy as possible for road users to comply.

Road safety education campaigns are also a well-used strategy in Australia and millions of dollars are invested in this approach every year. Unfortunately, many road safety messages are very broad and talk about road safety in general. This misses the opportunity to convey information to road users to help them use the road system more safely. Again, there are multiple examples. Many drivers, for example, re-merge after overtaking but do so too early, often startling the driver they have just overtaken and requiring them to brake suddenly. Similarly, many drivers are unaware of the safe ways and the dangers of using some driver assistive technologies in their vehicles, cruise control, for example. Road safety campaigns can be used to educate drivers on how they can be safer drivers, especially as vehicles became increasingly equipped with technologies that automate partially, or fully, some driving tasks. These approaches result from implementing human factors and ergonomics principles and should be incorporated into road safety strategies as soon as possible.

Summary and Recommendation

In summary, we need expand the focus of road safety by focussing on the elimination of human errors that are brought about by poorly designed elements of the road system. This is a collective responsibility. We need to work to eliminate design deficiencies in the road system that have the potential to confuse drivers, distract them, and overload them during the performance of activities critical for safe driving and, in turn, cause them to crash. This submission has presented four key strategies for incorporating human factors and ergonomics principles and practices that can be implemented right now to improve the effectiveness of road safety in Australia. We commend these to the Committee.



Please contact me directly or via the HFESA Secretariat if required.

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HFESA President

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