Striving for Safe System Speeds

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Abstract

A Safe System road can be achieved by matching the speed limit to the infrastructure or vice versa.

The idea of reducing the speed limit, at locations where the road environment changes, is not a new concept. For decades, when the road environment changed (ie. water over the road, rough surfaces, road events or roadworks), Victoria has reduced speed limits to mitigate safety risks. As we move forward, and with the increased understanding of the human tolerances to physical forces, will reducing speed limits at locations that do not meet Safe System speeds be as acceptable?

Victoria's current Speed Zoning Guidelines identify the need to manage vehicle speeds to balance society's desire for mobility with its need for safety, but also acknowledge the Safe System as a basis for implementing speed management. The Guidelines take significant steps towards achieving a Safe System. The recent inclusion of School Speed Zones and Strip Shopping Centre Speed Zones show a commitment to the progression towards a Safe System.

With limited funding available for infrastructure improvements to the road network, this paper discusses the issues associated with a speed limit policy that would achieve a true Safe System.

Keywords

Speed Limit, Speed, Outrage, Infrastructure, Public Acceptance, Safety

Introduction:

A Safe System road environment can be achieved immediately by reducing all speeds that are not currently consistent with the Safe System philosophy down to speeds that are. Under a Safe System, the travel speeds of vehicles should match the road environments. One way of achieving this is through speed limits. If speed limits were to be used to control travel speeds, the speed limits should be consistent with the possible crash types in the road environment and the biomechanical tolerances of humans. The speed limits that correspond with these biomechanical tolerances are as follows (based on Wegman and Aarts 2006):

- Roads with possible conflict between cars and unprotected road users: 30km/h
- Roads with possible impacts with fixed poles or trees: 30 – 40km/h
- Intersections with possible lateral conflict between cars: 50km/h
- Roads with possible head-on conflicts between cars: 70km/h
- Road where head-on and side conflicts with other road users are impossible: >100km/h

On Victorian roads, if speed limits were to be lowered to Safe System speeds the outrage amongst the community would be enormous. It is predicted that most of the speed limits would be raised as quickly as they were lowered. So as we move our road network towards a Safe System we need to consider public outrage when deciding what the appropriate measures are to take. As public opinion on speed limits is not currently based on Safe System philosophies there needs to be consideration of the public's outrage factor when setting speed limits.

Redefining risk:

VicRoads receives over 5000 items of written correspondence relating to speed limits each year. The issues raised generally fit into three categories: requesting a lower speed limit in the vicinity their local community (including schools**,** kindergartens and retirement villages), an increased speed limit on the correspondent's route of travel (the majority are rural roads) or a request for clarification on the justification of a speed limit. The overwhelming majority of those requests that seek a change in the speed limit are based on the perception of the correspondent and do not reflect the actual risk to the community as measured by road safety experts.

One explanation for the discrepancy between the vocal members of the public's expectation for speed limits and the actual risks associated with these issues is the concept of individual risk versus collective risk.

Consider the example of a request for an increased speed limit on a rural road with unprotected hazards in the clearzone and a crash history. There is overwhelming evidence that reducing speed limits on this road will reduce the risk of a crash, yet requests for increased speed limits outweigh requests for reduced speed limits on these types of roads. This risk reduction is measured as a cumulative risk for all road users. From the individual's perspective there may not appear to be a measurable reduction in risk and the individual weighs up this small increase in risk against time

savings and elects to accept a higher level of risk. However, when all these small increases in risk are added together, significant reductions in road trauma occur with speed limit reductions.

A slightly different concept may also explain some of the discrepancies between the public's expectation for speed limits and the actual risks associated with their issues of concern. This is the concept of artificially enhanced risk awareness. This usually occurs in situations where people are concerned for the protection of vulnerable road users. This is exemplified when a correspondent requests a 40km/h Remote School Speed Zone be introduced on a 50km/h speed limited road that is controlled with pedestrian operated signals and has a school crossing supervisor. In this case the evidence shows that the risk at this site is already very low, and introducing a 40km/h Remote School Speed Zone at this site would result in a negligible risk reduction. Yet these requests far outweigh requests for increased speed limits in similar scenarios.

Some areas of the current Victorian road environment meet a Safe System (when looking at the road environment, road use and speed limit), however there are still many areas that fall short of a Safe System. The greatest discrepancies exist on the high speed road environments (100km/h and 110km/h speed limits) with unprotected trees or poles close to the road, undivided rural roads and at-grade intersections. However, the majority of community concerns with respect to rural roads involve requests for increases in speed limits.

This leads to the question of why the risks on the road network that are causing the highest fatality and serious injury rates, and are furthest from a Safe System, are not the same as the risks that generate the bulk of public complaints.

In 1995 Beer and Ziolkowski identified that, at a macro level, populations perceive the risks of road crashes in line with the actual statistical risk. However, at a micro level, from the correspondence received by VicRoads, and the Monash University Accident Research Centre's investigation into *Community Attitudes to Speed Limits* (Lahausse et al 2009) the public "does not fully understand the consequence of speeding in relation to crash and injury risk, the environment, amenity and travel time". This provides a basis by which we can explore the reasons that, in many situations, Victorians perceive risks in different road environments in contradiction to the Safe System.

A similar concept was explored in the late 1980s in the USA with respect to environmental health risks. The US EPA was discovering discrepancies between the environmental health risks that were killing people and the environmental health risks that angered and frightened people.

In 1987, following the identification of this concept, Peter Sandman's now famous article Risk Communication: Facing Public Outrage was published in the *United States Environmental Protection Agency Journal*.

Sandman argues that addressing the factors that cause the greatest causality rate may not be the best factors to target to achieve the most benefit. Sandman also argues that risk communication is not an effective way to change the public's perception of that

risk, but that there is more benefit in policy makers understanding the public's perception of risk and shifting policy directions to take this into account.

The core problem is a definition. To the experts, risk means expected annual mortality. But to the public (and even the experts when they go home at night), risk means much more than that. Let's redefine terms. Call the death rate (what the experts mean by risk) "hazard." Call all the other factors, collectively, "outrage." Risk, then, is the sum of hazard and outrage. The public pays too little attention to hazard; the experts pay absolutely no attention to outrage. Not surprisingly, they rank risks differently. (Sandman 1987)

This changes our definition of 'risk' from the traditional equation:

risk = probability x consequence

to a new equation:

perceived risk = (probability x consequence) + outrage

or

perceived risk = hazard + outrage

Hazard:

Under Sandman's definition of risk, the term 'hazard' represents the traditional definition of risk (probability x consequence). We can infer that the further a road environment (and associated speed limit) are from a Safe System, the greater the risk.

As discussed, under a Safe System, road environments and their corresponding travel speeds must meet the biomechanical tolerances of humans. If speed limits are used to reduce travel speeds to be based on biomechanical tolerances, speed limits as follows would be required (based on Wegman and Aarts 2006):

- Roads with possible conflict between cars and unprotected road users: 30km/h
- Roads with possible impacts with fixed poles or trees: 30 – 40km/h
- Intersections with possible lateral conflict between cars: 50km/h
- Roads with possible head-on conflicts between cars: 70km/h
- Road where head-on and side conflicts with other road users are impossible: >100km/h

As there are limited funds for the implementation of infrastructure to bring all road environments into line with Safe Systems for their current speed limit, one approach is to reduce the speed limit to Safe System speeds for the existing infrastructure. However, this only takes into account the 'hazard' component and neglects the 'outrage' factor.

Outrage:

There are many outrage factors identified in the risk communication sphere. This paper will look at ten outrage factors and analyse how these alter the perceived hazard (or traditional risks) of the road environment, driving task and speed limit perception.

Voluntariness

Voluntarily exposing oneself to a risk is more acceptable to people than a forced risk. Consider the difference between smoking and being exposed to passive smoke. When it comes to speed management, speed choice is voluntary for the driver. Adding limits on the system increases outrage to drivers because a level of control is imposed on their choice of risk (dealt with below). In contradiction a pedestrian is forced to be exposed to the risks associated with a driver's speed choice or the speed limit thereby increasing the pedestrian's outrage.

Control

The majority of the population feels safer driving than being a passenger (Sandman 1987). When prevention and mitigation are the individual's choice, the tolerance to risk is much higher. This creates a distorted perception of the driver's risk. Thus, many drivers feel that they can safely drive at a faster speed than the speed limit and as a result are outraged at the posted speed limit.

Fairness

People who are forced to endure what they perceive as a greater risks than their neighbours, without access to greater benefits, have a high level of outrage. This is accentuated if the rationale for the perceived discrepancy appears to be the result of politics or bureaucracy rather than based on science.

The 'fairness' outrage factor is especially evident in the application of School Speed Zones across Australia. In Victoria, under the School Speed Zoning Guidelines (2005), speed limits have been reduced outside every primary and secondary school in the State, however this reduction only occurs on school boundary roads that have gates that are used for student access. As a result there are location (school crossings, pedestrian operated signals, intersection signals and other locations) where school children cross roads that do not have a School Speed Zone (commonly refereed to as a 'remote crossing'). This causes significant outrage from parents whose children cross the road at remote crossings.

Effect on Vulnerable Populations

The level of outrage increases with the vulnerability of a population. This includes the elderly, the sick and especially children. As a result, any speed limit linked to these populations would be viewed more favourably by the

public. Conversely, the perception of not protecting these members of the population with lower speed limits will cause outrage.

Identifiably of the Victim

The more identifiable the victim the higher the outrage. Unfortunately road deaths are categorised by statistics which create considerably less outrage. Thus, the majority of the population see road fatalities as an abstraction.

The TAC has invested in increasing the identity of road victims through advertising, however the population still sees road deaths and serious injuries as a generalised notion.

Morality

When society decides something is an unacceptable risk, a base for outrage is established. The 2010 Victorian Road Toll was 288 people killed and about 5000 people seriously injured. If next year 288 people were killed and 5000 serious injuries from, say dog attacks, the outrage level would be much higher than that if these figures were seen again in the road crash statistics.

Risk-Benefit Ratio

The risk-benefit ratio of greatest concern to the population is the risk-benefit ratio to themselves. A population is more willing to accept a risk when they feel the benefit to them justifies the risk, when they feel the sacrifice makes sense.

With respect to speed limit setting this equates to the individual vs collective risk covered above.

Familiarity

Unusual or mysterious risks increase outrage. Driving is a familiar task to many Victorians.

In the *International Journal of Risk Analysis*, 2006, Evans et al. show that a percentage of any population will drive between two destinations because they perceive the risks are too high to fly. However the statistics clearly show that the risk of driving is, at minimum, over 50 times that of flying. A critical factor in this anomaly is the familiarity of the risk associated with driving.

Memorability

A memorable crash such as the Kerang railway level crossing crash in 2007 makes a risk easier to imagine, and thus heightens the public's perception of risk. As a result reducing the speed limit to 80km/h at railway level crossings was generally accepted by the community.

Diffusion in time and space

Hazard A kills 50 anonymous people a year across the country. Hazard B has one chance in 10 of wiping out its neighborhood of 5,000 people sometime in the next decade. Risk assessment tells us the two have the same expected annual mortality: 50. "Outrage assessment" tells us A is probably acceptable and B is certainly not. (Sandman 1987)

Road crashes tend to fit into category A.

Where do we lower the speed limit and where do we invest in infrastructure?

Amongst the road safety community the Safe System is a well accepted philosophy. The general principles are easily understood and accepted. In Australia, the principles of the Safe System philosophy are filtering their way into the minds of road policy decision makers and road practitioners. However, understanding the public's outrage factor for speeds plays a critical role in moving towards a Safe System.

Sandman sums up the paradox in a unique way:

There is a peculiar paradox here. Many risk experts resist the pressure to consider outrage in making risk management decisions; they insist that "the data" alone, not the "irrational" public, should determine policy. But we have two decades of data indicating that voluntariness, control, fairness, and the rest are important components of our society's definition of risk. When a risk manager continues to ignore these factors – and continues to be surprised by the public's response of outrage – it is worth asking just whose behavior is irrational.

The solution is implicit in this reframing of the problem. Since the public responds more to outrage than to hazard, risk managers must work to make serious hazards more outrageous, and modest hazards less outrageous.

Thus, when considering the outrage factors around setting speed limits we need to follow this approach:

1. Identify the roads (taking into account exposure) that are furthest from a Safe System (or have the biggest hazard (probability x consequence)).
2. Try to increase the 'outrage' (in the direction agreeing with the Safe System philosophy) about the speed limit on these roads.
3. Invest in infrastructure to bring the road in line with a Safe System at the current speed limit.
4. Identify speed limits that have the highest outrage.
5. Analyse how far from a Safe System these roads are (or determine the hazard (probability x consequence)).
6. Change the speed limit if the outrage is directed at moving the speed limit closer to a Safe System speed. If the outrage is in the other direction, then infrastructure investment, long term public education or stonewalling are the only options.

When we follow these six steps for Victoria we find:

1. The roads furthest from the Safe System are the 100km/h and 110km/h roads with possible impacts with fixed poles or trees.
2. Increasing the 'outrage' (in the direction agreeing with the Safe System philosophy) for these speed limits with these conditions could be done through a variety of means, however this may take many generations. Another approach would be:
3. Investing in wire-rope safety barrier to eliminate the possibility of run-off-road crashes, thereby improving the road environment towards a Safe System without changing the speed limit.
4. The speed limits with the highest outrage in the community are around schools and areas with vulnerable road users.
5. When analysing these from a Safe System perspective any area above 40km/h is inconsistent with a Safe System.
6. If infrastructure is not easily available to mitigate the risk to the vulnerable road users, then speeds limits in these areas should be lowered to 40km/h (assuming a reasonable level of exposure).

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