‘VISION ZERO’ AND ‘SUSTAINABLE ROAD SAFETY’

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Prepared: 31 June 2002.

1. A BRIEF STATEMENT OF THE ISSUE

A new theoretical approach to road safety has recently emerged from Sweden entitled ‘Vision Zero’, which states that no level of death or serious injury from the road system is acceptable in civilised society. The Netherlands has developed ‘Sustainable Safety’ as a closely related approach, with the aim of creating a traffic system in which any crashes that occur need to exclude the possibility of serious injury.

Both approaches recognise that the efforts of education and enforcement notwithstanding, road users will remain fallible. The primary task, therefore, is to design the transport system and the road network in particular, to accommodate human error.

This paper addresses traditional, Vision Zero and Sustainable Safety theory and the benefits and disadvantages associated with all three approaches.

2. THE TRADITIONAL APPROACH TO ROAD SAFETY

The traditional road safety model accepts that mobility is important and desirable within our society. Although safety is also important, it is effectively traded-off at the point at which mobility options are unacceptably threatened. The traditional model implicitly assumes that some measure of road trauma is acceptable.

This model, most particularly in a road engineering context, uses benefit-cost analyses to find the appropriate balance between safety and mobility, by costing safety benefits and mobility losses in terms of dollars and cents. If a safety countermeasure does not produce a sufficient benefit-cost-ratio, discounted for traffic delays and other mobility restrictions, it is generally overlooked. As a specific example, the initial Australian national black spot program for road improvements only considered remedying hazardous locations where the overall benefit-cost ratio exceeded 2:1[1].

(At the same time, it needs to be recognised that elsewhere, political and other considerations can outweigh this economic approach. As a specific instance, the debate as to whether seat belts should be installed on school buses continues, despite the economic evidence arguing strongly against this countermeasure.)

The traditional model has been associated with considerable progress in reducing the road toll in Australasia over the last 30 or so years and, as a general approach, is widely accepted by politicians, industry, government agencies, researchers and the community generally. However, in Australia the national road toll has stabilised over the last 4 or 5 years, averaging around 1800 deaths annually.

Increasingly, it is being questioned whether the traditional model remains the most appropriate means to meet current national and state road safety targets. The fatality levels in New Zealand are continuing to decline but that country is also looking to other means to hasten further improvements.

Both Vision Zero and Sustainable Safety offer new strategies to further reduce the road toll in both countries.

3. VISION ZERO AND AUSTRALASIAN ROAD SAFETY

3.1 What is Vision Zero?

Vision Zero has as its starting point the proposition that it is unethical to consider human life and health as tradable: the system must place priority on preventing death and serious injury ahead of all other considerations, including mobility, even if this entails radical changes to the current traffic system[2].

It also departs from traditional road safety theory regarding the issue of blame or fault. It states that blaming the driver as being responsible for the crash glosses over the real fault, which is more likely to be the system or environment in which the human operates. The inherent failings of current road and transport systems can be illustrated by the following exercise. Using the Norwegian system as an example, it has been estimated that if all road users complied totally with all road rules, fatalities would fall by almost 50 per cent and injuries by 30 per cent. Even under optimum conditions, over 40 per cent of fatalities and 70 per cent of injuries would, therefore, remain[3].

The perceived task in Vision Zero, therefore, is to redevelop the system so that it will become more crashworthy and, in particular, more forgiving of the mistakes likely to be made by road users. The development of a crashworthy system entails an examination of the complete driving environment (vehicles, roads, the surrounding physical environment, traffic mix and so on), particularly to manage crash energy so that no user is exposed to possible impact forces capable of causing death or serious injury. In Vision Zero terminology, crash energy must not exceed the biomechanical tolerance of humans.

The various means to achieve this (some of which have already been implemented, others of which are still being developed) include[4]:

- reduction of traffic speed so that collisions will be of low impact;
- provision of physical separation of the vehicles or user groups likely to come into conflict on roads which maintain speeds high enough to lead to serious injury, for example, through median barriers or by providing separate pathways for cyclists;
- provision of more forgiving roadside environments to reduce the severity of any injury occurrence on roads which maintain high speeds, for example, through guard barriers and adequate clear zones;
- improved vehicle occupant protection to reduce the chances of injury in the event of a collision eg through airbags and crumple zones;
- general improvements in vehicle design, for example, to ensure greater stability while travelling, incorporation of crash avoidance systems, and features to reduce injury to other road users, especially pedestrians.

3.2 The arguments for and against Vision Zero

On one hand, opponents of Vision Zero maintain that it is impossible to achieve and is setting unrealistic targets[5]. They argue that the required restrictions placed on personal mobility and freedom are unacceptable in our highly mobile society. Furthermore, the funding required to achieve a zero road toll will not come easily and will require a radical re-think of spending priorities within government budgets. If Vision Zero is favoured, this will probably mean funds being diverted from other equally important causes.

On the other hand, its supporters argue that the notion of whether Vision Zero is achievable or not, misses the point. It remains that is ethically unacceptable to trade human life and health against the joys of speeding or rushing to get to a meeting on time. Furthermore, they claim that the benefits of mobility are over-stated. While it is possible to place monetary values on lost time due to lower speeds and delays, time losses on individual trips, especially in urban areas, are invariably small and of no discernible consequence. Vision Zero proponents also argue that continuing to blame the individual users will forever deflect attention from the mistakes of those responsible for planning, constructing and managing the road system.

3.3 Vision Zero's possible contribution to Australasian road safety

A system-wide approach

Vision Zero seeks to examine road safety problems using a multidisciplinary approach involving road and traffic engineers, enforcement agents, vehicle designers, medical specialists, educationalists and trainers, researchers, sociologists, government officials, and many other professional groups as well as the community generally. It is contended that these different participants can learn from and support each other in formulating and implementing new countermeasures and programs that address the various causes of road trauma, rather than road safety being viewed as the domain of a particular agency or organization.

Developing a more crashworthy system

Inappropriate driver behaviours and attitudes contribute to many crashes on our roads. However, this does not free the overall system from responsibility for preventing these crashes. Vision Zero argues that a system can be considered appropriately designed only if it takes account of the full range of likely user behaviours, even if some of those behaviours are inherently risky. At a greater extreme, a system that directly precipitates unsafe user behaviours (for example, by encouraging a mix of high-speed vehicles without also providing adequate crash-preventive measures) is, clearly, inappropriately designed.

It should be noted that Vision Zero does not argue against the need for educational and other programs to curb inappropriate behaviours such as speeding, driving while fatigued or driving under the influence of performance-disabling drugs. It does argue that for as long as we can expect inappropriate behaviours to be present, the system needs to strive to protect drivers (and their victims) from the deleterious effects of such behaviour.

Roadside hazards represent an example of the need for improved system crashworthiness in Australia. Vehicle safety has improved by up to 50% over the last 20 or 30 years through improved vehicle design and the inclusion of new safety technology such as airbags[6]. However, it remains that in each Australian jurisdiction much of the road network runs through natural forests and roadside plantations or beside telegraph poles. The advances in vehicle crashworthiness notwithstanding, cars often cannot absorb the extremely high levels of impact energy when crashing into a tree or pole at highway speeds.

The means to develop a crashworthy system in accordance with Vision Zero principles include:

- safer roads, especially to prevent the vehicle from leaving the roadway
- more forgiving roadside settings
- complementary designs between cars and roadside barriers
- passenger vehicles offering high levels of crashworthiness and crash avoidance
- reduction in vehicle mass discrepancies.

Maintaining mobility

A principal strategy relied upon by Vision Zero is to reduce impact speed in the event of a crash. This is most directly achieved by reducing travel speed to levels where those involved will not experience life-threatening injuries.

However, it also needs to be noted that many of the infrastructure improvements advocated by Vision Zero - for example, the use of median barriers to separate vehicles travelling in opposite directions - will allow vehicles to continue to travel at current speed levels.

Technological solutions

It is unlikely that the permanent speed reductions to the level required for a zero road toll will be achieved only though behaviour changes induced by engineering and enforcement programs. Vision Zero thus relies upon current and emerging technology (for example, headway control devices to reduce tailgating) to assist in bringing about these changes.

Fatalities and harm

For every death on the road, there are likely to be around 15 survivable hospital admissions and approximately 85 non-hospitalised survivors, with many of the non-fatal injuries resulting in serious long-term, and perhaps permanent, impairment. Vision Zero can assist in changing our preoccupation with fatality reduction (as reflected in Australia's current national road safety strategy) to harm reduction, as is already reflected in the New Zealand national road safety strategy. This widening of scope is a key objective of Vision Zero.

3.4 En route to Vision Zero

The Swedish city of Trollättan is currently involved in an innovative demonstration program applying many of the principles espoused by Vision Zero[7]. It has a road circuit comprising 33 km of main roads and 6 km of local streets, which uses a number of infrastructure improvements and mobility changes. Saab in Sweden has also provided a number of vehicles fitted with alcohol interlocks, intelligent speed adaptation devices and seat belt reminder systems as part of the trial. In addition, the City of Trollättan has established an extensive hands-on exhibition aimed at informing and educating policy makers, school children and the public generally on relevant road safety issues.

The program was developed using a system-wide approach whereby key stakeholders and experts were brought together to develop the program. In addition, the public was involved through an extensive consultation process as the program was being developed.

Examples of some of the key strategies and interventions of the program include:

- wire rope barriers to divide hitherto undivided main roads, to reduce head-on collisions
- wire rope barriers on the side of the road, to minimise rollovers and run-off-road contacts with trees
- lower speed limits to reduce impact energy of collisions. These limits include 90km/h on major highways, 70km/h on major collectors, 50km/h on other main streets and 30km/h on local streets
- enforcement on main roads supported by camera technology while lower speed limits are also supported with LATM on-road measures
- extensive use of roundabouts on all road classes to minimise both the number of crashes and the outcome consequences of side impact collisions at intersections
- local street design changes to restrict vehicle movements and provide more provision for pedestrians and unprotected road users. This includes the provision of pedestrian-only precincts, bike paths, pedestrian crossings and centre road refuges
- a change in road-user priority from vehicles to public transport and pedestrians. On local streets, novel bus stops have been introduced where curbs have been extended to provide sufficient space for a bus only. Thus, when the bus stops, the road is effectively blocked and other traffic must stop until the bus moves on.

4. SUSTAINABLE SAFETY'S POSSIBLE CONTRIBUTION TO AUSTRALASIAN ROAD SAFETY

4.1 What is Sustainable Safety?

The aim of Sustainable Safety is to create a traffic system in which the probability of a crash is limited by means of an inherently safe road environment. In the event that crashes do occur, the aim is to exclude the possibility of serious injury by virtue of improvements in the road, the roadside and in the vehicle[8].

Sustainable Safety views the road user as the weakest link in the transport chain[9]: the individual road user is largely unpredictable and cannot be relied upon to behave safely over the long term, education and information efforts notwithstanding. Sustainable Safety looks primarily to the road infrastructure and to vehicle performance:

- the road network and infrastructure needs to be predictable and should more or less automatically elicit the correct safe behaviour;
- vehicles need to be designed and equipped to simplify the human task and to allow errors to be less catastrophic.

The road network, which is foremost in sustainable safety planning, relies upon three key principles for improvement:

- functionality – whereby the road network consists of three mutually exclusive sub-classes of road, each with its own characteristics and restrictions. The sets of roads are: through roads to cater for long distance, high speed, high volume travel; distributor roads serving districts, regions and suburbs; and access roads directly serving street-side properties;

- homogeneity – whereby large differentials in vehicle speed, mass and direction along any given road are prevented. Flow roads, for example, are closed to bicycles since speed and mass differences are too large between them and other vehicles, and traffic moving in opposite directions is separated;
- predictability – whereby the road network and individual roads and streets are clear and unambiguous regarding function and rules, the other types of road users that might be encountered and the range of behaviours that might be expected.

These principles have been accompanied by sets of functional requirements, operational requirements and design guidelines to ensure that theory is being translated into practice[8].

4.2 The arguments for and against Sustainable Safety

Although both the Sustainable Safety and Vision Zero models rely heavily upon widespread changes to the road network, Vision Zero seems to have prompted more opposition, perhaps because of the implicit challenges of its title. However, much of the opposition to, and defence of, Vision Zero is equally applicable to Sustainable Safety.

4.3 Sustainable Safety's possible contribution to Australasian road safety

Sustainable Safety represents an alternative approach to considering how further road safety improvements might be made in Australasia. As was the case with Vision Zero, its possible contributions fall into the following areas:

- an emphasis upon a system-wide approach that involves all key players in developing effective and lasting road safety solutions;
- an emphasis upon developing a crashworthy system, thereby shifting attention from the failings of individual road users to a road infrastructure more forgiving of those failings;
- a heavy reliance upon controlling speed distributions across the road network;
- extensive use of technology, particularly in creating safer roads and safer vehicles;
- extending the consideration of harm reduction from fatalities to include other injuries.

4.4 En route to Sustainable Safety

The Netherlands' approach to Sustainable Safety has included a comprehensive set of measures to be implemented by 2010[8]. Taking only the rural distributor roads as an example, these measures include:

- the introduction of parallel or alternative facilities for slow traffic and/or local traffic;
- separation of opposing driving streams, with an upper speed limit of 80 km/h;
- creation of roadside obstacle-free zones;
- speed reduction measures at intersections, especially roundabouts.

Looking at all road types, the estimated benefits by 2010 are presented in Table 1.

Table 1: Projected reduction percentages in the rates and severity of injury accidents on various road types in the Netherlands through sustainable safe measures in 2010, compared to those obtained in 1998.

Road type	Reduction in the no. of injury accidents per million motor vehicle kms (%)	Reduction in the no. of fatalities per 100 victims (%)
Through road	19	10
Rural distributor road	44	20
Rural access road	19	20
Urban distributor road	54	10
Urban access road	24	20

Source: Van Schagen and Jans-sen (2000)

To assist in the implementation of these measures, a number of demonstration projects have been established in the Netherlands[9]. As an example, the main aim of one project is to re-engineer the urban road network for the town of Oosterbeek, particularly in regard to a major road that carries both through and local traffic. Proposed safety improvements include:

- diverting some of the through traffic;
- improving public transport;
- improving the operation of the main road;
- creating public awareness of, and support for, the project and its measures;
- developing a road network plan backed by appropriate infrastructure provisions.

5. CONCLUSION

As road safety philosophies, Vision Zero and Sustainable Safety both differ from the traditional mobility model by regarding any level of serious road trauma as unacceptable. They call for a different, more collaborative, approach in addressing safety issues, requiring less blame to be placed on the driver and a stronger focus on creating a safe travel environment where driver errors can be better tolerated. A key strategy is to manage speed levels so that crash impact forces do not exceed human tolerance.

Is it possible to eliminate all injuries from the road network? Probably not, but the limited evaluation evidence to date suggests that both the Vision Zero or Sustainable Safety approaches promise a substantially reduced level of road trauma. Over time, this evidence is expected to strengthen. It remains to be determined whether the accompanying restrictions in mobility and increases in infrastructure spending costs will be acceptable to society.

REFERENCES

[1] Bureau of Transport and Communications Economics (1995). *Evaluation of the black spot program*. Report 90, Australian Government Publishing Service, Canberra.

[2] Elvik R (1999). Can injury prevention efforts go too far? Reflections on some possible implications of Vision Zero for road accident fatalities. *Accident Analysis and Prevention,* 31, 265-286.

[3] Elvik R (1997). '*Traffic laws, control and sanctions. The potential for improvements of road safety and the benefits and costs for different measures*.' The Norwegian Institute for Transport Economics, Notat, 1073/97, Oslo.

[4] Carlssonn G (1988). Paper (title undetermined) presented at the PRI 8th World Congess in Lisboa, Portugal, 8-10 June, 1998.

[5] Karyd A (2001*). Sweden's vision zero – the least mourned traffic casualty*. Paper presented to the Traffic Safety on Three Continents Conference, Moscow.

[6] Newstead SN, Cameron M & Le C (2000*). Vehicle crashworthiness and aggressivity ratings by year of vehicle manufacture*. Report No. 171, Monash University Accident Research Centre, Australia.

[7] Fildes B (2001). *Achieving the national strategy targets – a role for Vision Zero?* Paper presented to the Road Safety Research, Policing and Education Conference, Melbourne.

[8] Van Schagen I & Janssen T (2000). *Managing transport risks – Sustainable safety in the Netherlands*. IATSS Research, 24 (2), 18-27.

[9] Van Vliet P & Schermers G (2000). *Sustainable safety a new approach to safety in the Netherlands*. Ministry of Transport, Public Works and Water Management, Rotterdam.