Vision Zero - An ethical approach to safety and mobility

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ABSTRACT

Vision Zero is a philosophy of road safety that eventually no one will be killed or seriously injured within the road transport system. This paper describes Vision Zero and its view that safety cannot be traded for mobility. The applicability of Vision Zero to Victoria in the short- and long-term is discussed.

THE VISION ZERO

In October 1997, the Road Traffic Safety Bill founded on Vision Zero was passed by a large majority in the Swedish parliament. The Vision Zero is that *eventually no one will be killed or seriously injured within the road transport system* (Ministry of Transport and Communications, 1997). The Vision is an expression of the ethical imperative that

It can never be ethically acceptable that people are killed or seriously injured when moving within the road transport system.

Vision Zero addresses fatalities and those injuries where the victim does not physically recover within a certain period of time. This means that common, but not long-term disabling injuries, and non-injury accidents are more or less outside the scope of the Vision.

Vision Zero provides a vision of a safe road transport system which can be used to guide the selection of strategies and then the setting of goals and targets. Zero is not a target to be achieved by a certain date. It is a change from an emphasis on current problems and possible ways of reducing these to being guided by what the optimum state of the road transport system should be.

Vision Zero also changes the emphasis in responsibility for road traffic safety. In all current road transport systems, the road user has almost total responsibility for safety. In most countries, there are general rules that the road user should behave in such a way that accidents are avoided. If an accident occurs, at least one road user has, by definition, broken the general rule and the legal system can therefore act.

In contrast, Vision Zero explicitly states that the responsibility is shared by the system designers and the road user:

"1. The designers of the system are always ultimately responsible for the design, operation and use of the road transport system and thereby responsible for the level of safety within the entire system.

2. Road users are responsible for following the rules for using the road transport system set by the system designers.

3. If road users fail to obey these rules due to lack of knowledge, acceptance or ability, or if injuries occur, the system designers are required to take necessary further steps to counteract people being killed or seriously injured."

'Ethical rules' have been proposed to guide the system designers. Two of these are:

- "Life and health can never be exchanged for other benefits within the society"
- "Whenever someone is killed or seriously injured, necessary steps must be taken to avoid a similar event".

SAFETY AND MOBILITY

Vision Zero states that the loss of human life and health is unacceptable and therefore the road transport system should be designed in a way that such events do not occur. This means that safety is a more important area than other issues in the road transport system (except for health-related environmental issues). Mobility therefore should follow from safety and cannot be obtained at the expense of safety.

Since safety and mobility cannot be traded against each other, then mobility becomes a function of safety, not vice versa. The safer the road infrastructure, the greater mobility is afforded. In Vision Zero, speed is often used as an operational definition of mobility. Thus, Vision Zero states that speed must be limited to a level commensurate with the inherent safety of the road system. This is a true paradigm shift and contrasts to the more general principle, where human life, mobility and other benefits and problems are weighted against each other.

In the background paper to the Swedish parliament written by the government, the following sentence is probably the most important: "…the speed limits within the road transport system should be determined by the technical standard of vehicles and roads so as not to exceed the level of violence that the human body can tolerate. The safer the roads and vehicles, the higher the speed that can be accepted."

FROM VISION TO STRATEGY

The most important part of the vision and the meaning of 'Vision Zero' is that "no foreseeable accident should be more severe than the tolerance of the human in order not to receive an injury that causes long term health loss". If a virtually safe system is going to be designed, either the harmful event must be eliminated, or it should not reach the limit of the human tolerance. In the Vision Zero concept, it is assumed that accidents cannot be totally avoided, hence the basis for this concept is built around the human tolerance for mechanical forces.

The risk of an injury can be seen as a dose-response function, where injury is a result of mechanical forces. Accidents involve more or less mechanical force, often described as the accident severity exposure. If the accident exposure, or the mechanical forces, could be kept

below the threshold for a serious injury, we have a virtually safe system. To keep the exposure under the threshold, we can either eliminate all accidents over the limit, or increase the ability to withstand forces. These are elements known as accident prevention and injury prevention.

There is always one parameter that can be used to dramatically increase safety: that is to reduce mobility, either for some road user categories, or to reduce speeds down to a level where accidents do not cause serious injuries. The correlation between speed and safety is one of the best-known relationships in the road safety area, both theoretically as well as empirically. If nothing is done to the inherent safety of the system, mobility can be reduced to such levels where almost no accident causes serious injury.

Accident prevention and injury prevention become somewhat blurred when traffic safety is modelled in this way. The reduction in exposure to mechanical force can be achieved not only by avoiding accidents, but also by modifying it to fit into the human tolerance, sometimes filtered by protective systems. A safe intersection for cars is not an intersection without accidents, but an intersection where no possible accident will lead to a serious health loss. In fact, a safe intersection might be one where there are more accidents than occur in a less safe solution.

It is quite obvious though that the focus must be set on the interface between the different components of the system (speeds, roads, vehicles). The safe intersection might only be safe for occupants that are properly restrained in a vehicle with a certain level of crashworthiness. At the same time, it might be unrealistic to develop a safe road for unbelted occupants. The interfaces must therefore be defined, but only to such a degree that they will be realised. This definition will make it quite clear what the limitation of a car is, as well as the road. The car will probably never be able to protect its occupants in head on collisions with trucks over a certain velocity, even if the front end of the truck is deformable. In this sense, the automotive industry and the infrastructure designers that will largely set the future speed limits.

Vision Zero has many parallels to approaches to environmental issues, both setting criteria related to what the human being can tolerate. The Swedish Ministry of Transport and Communications has stated that "it is highly essential that the work on road traffic safety be co-ordinated, as far as possible, with the overall work on environmental issues and the work on other closely related areas of activity (such as the work environment, health and welfare promotion, crime prevention etc.). This is partially due to the fact that this work is largely based on grass-roots commitment and partially because of the common ambition to prevent health impairment and crime both today and tomorrow" (Ministry of Transport and Communications, 1997, p.13).

IMPLICATIONS FOR SPEED MANAGEMENT

Vision Zero describes the end product of a safe road transport system. While such a system can be achieved by eliminating all accidents, this is not likely to happen, even with advanced ITS techniques. Therefore the system must rely on a balance between travel speeds and the inherent safety of infrastructure and vehicles. By assuming a certain level of vehicle safety, long term guidelines for maximum actual speed related to the infrastructure can be set. These guidelines form the basis for sustainable investments into the infrastructure, and can be used as options in redesigning the infrastructure.

For example, the human tolerance for a pedestrian hit by a well-designed car will be exceeded if the vehicle is travelling at over approximately 30 km/h. If a higher speed in urban areas is desired, the option is to separate pedestrian crossings from the traffic. If not, pedestrian crossings, or zones (or vehicles), must be designed to generate speeds of a maximum of 30 km/h.

The same arguments could be used for infrastructure where only cars can collide. While the inherent safety of well-designed cars can be anticipated to be a maximum of 70 km/h in frontal impacts, and 50 km/h in side impacts, higher speeds can be tolerated if the interface between the vehicle and the infrastructure is well designed. Speeds over 100 km/h can be tolerated in the future. It can be assumed that every step in the direction to fulfil these guidelines will be positive in terms of reducing the road toll.

While Table 1 shows the end product of an inherently safe system, not producing serious or fatal injuries, which should be the goal of speed management. The key issue is that such a strategy is sustainable and allows substantial investments that will not be obsolete over any foreseeable time frame. It must be noted that the success of such a strategy is based on a certain development of vehicles and restraint use in order to give maximum benefit. It is also based on the assumption that the road user is encouraged or forced to use the system in the intended way.

Table 1. Possible long term maximum travel speeds related to the infrastructure, given best practice in vehicle design and 100% restraint use.

Type of infrastructure and traffic	Possible travel speed (km/h)
Locations with possible conflicts between pedestrians and cars	30
Intersections with possible side impacts between cars	50
Roads with possible frontal impacts between cars	70
Roads with no possibility of a side impact or frontal impact (only impact with the infrastructure)	100+

APPLYING VISION ZERO IN VICTORIA

The traffic safety strategy in Victoria has been mainly focused on high-profile measures directed at the road user and progressive improvements to the road system. Speeding and drink driving measures seem to be the main areas that have created the success in reducing the number of fatalities and injuries in the beginning of the 1990s.

Vision Zero focuses on the inherent safety of the road transport system, as well as safe use of the system. Given no change to the inherent safety of the system, the only radical way to drop the road toll is to reduce travel speeds. If this does not seem acceptable, especially as speeds would have to be dropped substantially, the alternative is to invest to improve the inherent safety of the system, with a more or less given mobility. These investments will be mainly directed towards the infrastructure.

As the main design factor in Vision Zero is the biomechanical tolerance of the human in the case that a potentially harmful event occurs, the main investments into the infrastructure should aim to control speed where there is a potential for conflict with other vehicles and to provide a better interface between the passive safety of the car and the infrastructure when a car leaves the intended direction. More specifically, investments should mainly be directed to interventions creating speeds below the threshold or grade-separated intersections.

Other investments should be directed towards more forgiving roadsides and large separation where speeds exceed, say, 60-70 km/h. For pedestrian safety, vehicle speeds must be restricted to 30 km/h where there are vehicle-pedestrian conflicts, or alternatively cars and pedestrians should be physically separated.

To increase the inherent safety of the road transport system based on Vision Zero is not in conflict with general investment in the road system. A more system-oriented approach must be developed in co-ordination with the automotive industry. In order to improve the interface between vehicles and the infrastructure, the interface must be defined and developed. The vehicle must be able to guarantee seat belt use, a sober driver and limitation of speed. The infrastructure must be developed to cope with a variety of vehicle types.

Vision Zero is a long-term vision which can guide the development of strategies but it does not prescribe the content of strategies. There are no obvious conflicts between other strategies and Vision Zero, other than those strategies which rely on fewer errors made by the road user. The general recommendation from Vision Zero is that strategies should incorporate linking speed to the technical standard of the system.

In the short term, the implication of Vision Zero in Victoria would be to invest differently into road traffic infrastructure. In order to make a substantial change to safety within a reasonable time, large investments would be needed, mostly related to traffic calming, improved intersections and well designed barriers on high-speed roads. Speed limits would need to be reduced in areas where improving the infrastructure is not an option.

An operational strategy

While it is desirable to have political commitment to the sustainable development of a safe road transport system, it is not necessary in the short term. Therefore, an operational strategy can be outlined and some important steps can be taken fairly soon. It must be stressed though, that some of the components of the strategy will not give an immediate effect. While these components will eliminate a certain problem in the long run, they must be complemented with more short-term strategies. Seat belt interlocks, as an example, will only have a very limited effect in the beginning, probably not addressing non-use of seat belts within five years, but then gradually have a substantial effect later. Non-wearing of seat belts must therefore be addressed with other methods in the short term. The three areas below address the inherent safety of the system as well as a safe way of using it.

The most important steps in an operational strategy are:

A. Gradually aligning vehicle speed to the inherent safety of the system

A first step would be to "rate" the infrastructure-speed in terms of safety and compare the end product with the current situation. This will give a good picture of where it is most effective

to either reduce speed or modify the infrastructure. Generally, four aspects should be considered in a rating system. All of these aspects contribute to determining the safe travel speed:

- Roadsides
- Lane separation
- Intersections
- Unprotected road users

A road receives a top ranking if it fulfils the requirements in Table 1, but it is important to describe the intermediate steps, so that even small modifications are recognised. The amount of traffic can be a parameter showing the importance of modifying the system. This is an alternative to using accidents as a way to identify problems, and will make it clear what actions must be taken at each spot or road, in order to eliminate the role of the infrastructure in producing harm.

The ranking will produce an end product that can be used for long-term planning and for demonstrating the options in producing an inherently safe system. The ranking system can also be seen as a performance indicator of the inherent safety of the system.

B. Improving vehicles to address driver behaviour issues

At least two, possibly three, major steps, can be taken in terms of vehicle safety:

- Seat belt interlocks
- Alcohol interlocks
- Intelligent speed limiters

While there are problems in relying on the market to stimulate the demand for these devices, it is nevertheless very important that these devices will in the long term have a substantial impact, especially within a safer infrastructure.

The implementation process can be designed in many different ways, allowing both regulation and market demand. One way of promoting the development of such systems is to form an alliance of fleet buyers of cars that will gradually start to demand vehicles with the devices. The role of insurance companies should not be underestimated, as well as building partnerships with the automotive industry. The phasing out of older cars should also be considered in a market-oriented approach.

C. Stimulating the community to use the system in a safer way

The role of corporate behaviour can be used to build quality systems within organised use of the road transport system. By demanding professional users of the system to focus on issues like speed, fatigue, purchase of cars etc, a large proportion of the traffic can be influenced. It is important to see this as a demand-driven process rather than regulatory in the short run. State and local government could start this process, being major users of the road transport system. Producing a safe system of transportation would both affect transport within the organisation as well as transport provided by others (taxis, rental cars etc).

Quality of transport within a corporate behaviour strategy would benefit from finding synergies with economy and environmental issues. Quality of transport could be followed up with performance indicators, such as choice of vehicles, fuel consumption etc. Fuel consumption and emissions are related to each other, as well as to safety (in terms of speed and non-aggressive driving). It is recommended that fuel consumption be used as a performance indicator for all transport operations.

In the short term, a "safe" way of using the road transport system should be defined, in order to help the market, preferably in a way that suits modern quality management systems, such as ISO 9000 and 14000.

CONCLUSIONS

Vision Zero is a long-term strategy in which the system and its use are gradually integrated and where the responsibility for safety gradually becomes shared by the designer and the user of the system. Such a system that is built on tolerating human error leads sooner or later to a changed pattern of responsibility within the automotive industry, road engineers and traffic planners.

"In a broad sense, the decision [to adopt Vision Zero] stimulates innovations and investments into the road transport system, and gives a new perspective as to how the society can handle different actors in a complicated world. If mobility is what society wants, it can only reach that by an increased inherent safety. If safety is what society wants, it can be reached in two ways – reduce mobility or invest in safety." (Tingvall, 1998, p.8)

REFERENCES

Ministry of Transport and Communications. (1997). En route to a society with safe road traffic. Selected extract from Memorandum prepared by the Swedish Ministry of Transport and Communications. Memorandum, DS 1997:13.

Tingvall, C. (1998). The Swedish ‘Vision Zero’ and how parliamentary approval was obtained. *Road Safety Research. Policing. Education Conference. 16-17 November 1998, Wellington, New Zealand. Proceedings: Volume 1.* Land Transport Safety Authority. New Zealand Police. pp.6-8.

About 1.4 million people die each year in traffic accidents globally, making it the ninth most common cause of death. Although Sweden is one of the countries where you are least likely to die in a car crash, the new way of thinking means that even Sweden’s low fatality figures are now seen as unacceptable.

Zero tolerance for crashes

The basic idea behind the Vision Zero policy is this: serious injuries and deaths on the road should not be tolerated. Until recently, crashes and fatalities on the roads were seen as a necessary evil to be accepted in the interests of personal mobility.

Sweden has always been at the forefront of road safety – it was one of the first countries to require seatbelts for both front and rear passengers – but the results have still been astonishing. Central safety barriers have reduced head-on smashes by 80 percent, lowering

speed limits in urban areas has reduced injuries to cyclists and pedestrians by 50 percent, and a new law requiring children under the age of 15 to wear helmets is expected to reduce this figure even further.

From 1997 to 2006 fatalities on Swedish roads were reduced from 541 to 431, but 2000 was a black year with 591 dead. Source: Vägverket/OECD

Accidents will happen

Claes Tingvall, director of traffic safety at the Swedish Road Administration (*Vägverket*), is known as the father of Vision Zero. "We in the transport sector have not intentionally killed people, but safety has not been the main concern," he says.

Key to Vision Zero is the radical notion of moving responsibility for accidents away from road users and on to those who design the road transport system. "A couple of hundred years ago it was said that people got diseases because they were immoral and they weren't living according to God's will, and it's still more or less the same with crashes," says Tingvall. "We have come to understand that bacteria and viruses make us ill. But crashes and injuries are still very much blamed on the victim for being stupid or irresponsible."

Claes Tingvall has made a name for himself as the architect of the Swedish Vision Zero policy. Photo: Hasse Eriksson

Vision Zero accepts that accidents will happen, so the best course of action is to try to minimize the effects: traffic is slowed, intersections are redesigned, guard rails put up, and rigid roadside objects like trees and rocks are removed.

Safety through technology

Sweden's car industry has also played a key role in reducing accidents. The country's two main carmakers, Volvo and Saab, have a top reputation for safety. Volvo engineer Nils Bohlin patented the three-point seatbelt in 1958, and Volvo was the first car manufacturer in the world to fit them as standard the following year. Ingrid Skogsmo, director of Volvo Cars' Safety Center, says: "Reducing the number of fatalities requires a mixture of people, vehicles and infrastructure, so we aim to provide the safe vehicles."

Skogmo's team in Göteborg is working on a range of advanced technologies to prevent accidents. One such is automatic braking. "In our Volvo S80 you have collision warning with brake support," says Skogsmo. "A radar in the grill of the car monitors the distance to the car in front of you. If you get too close there is an audio signal and a light flashed up onto the windscreen. At the same time we move the brake pads to the wheels so that once you react no time is lost."

Half asleep behind the wheel? Swedish Volvo has engineered an optical radar system to help drivers avoid collisions at low speeds. Illustration: Volvo

Other technologies under development in Swedish labs include highly sensitive built-in alcohol sensors, night vision systems similar to those used by the military and adaptive cruise control to maintain a safe distance between vehicles.

Hysterical response

Tingvall says the international response to Vision Zero has been “almost hysterical.” “The interest has been enormous. We're trying to have an interaction both with countries that have very good traffic safety but also with others, like China, that really have a problem now with a growing economy and increased motorization.”

Professor John Whitelegg, transport expert at the Stockholm Environment Institute at York University in England, is pushing to get a similar policy introduced in the UK. He believes that were he to succeed – although he’s not confident he will – road fatalities there could be reduced from about 3,000 today to close to zero in 20 to 25 years.

Many countries have a long way to go to reach Sweden's low fatality figures. Source: Vägverket/OECD

“When Vision Zero was unveiled, no one even entertained the idea that it was possible to think in terms of reducing the number of fatalities and serious injuries to something that was tiny or zero,” Whitelegg says. “But it’s a remarkable achievement for Sweden and it’s still reverberating around the world.”

While the Vision Zero policy may not be taken up in the UK, it has been embraced from Norway to Australia, and the Swedish national obsession with safety is now saving lives around the world.

Road Safety Interview: Sweden’s Vision Zero

Road accidents are inevitable in a mobile society. Wrong, says Claes Tingvall, of the Swedish Road Administration and an architect of the Vision Zero policy that envisages a road traffic system with no accident fatalities.

Claes Tingvall, Director of Traffic Safety, Swedish Road Administration

"We know we won’t reach zero, but we could probably reduce road accident fatalities by 80 to 90 percent by adopting these fundamental principles."

No more fatalities on our roads. How could this be possible?

The Vision Zero policy is not a figure; it is a shift in philosophy. Normal traffic policy is a balancing act between mobility benefits and safety problems. The Vision Zero policy refuses to use human life and health as part of that balancing act; they are non negotiable.

Today's systems assume that humans don't make mistakes. If you make a mistake for two seconds, you might be killed. We have effectively been forbidden to crash since the 1920s. But the system should tolerate mistakes, and this policy says explicitly that you should design the system on the basis of human failure.

We know we won't reach zero, but we could probably reduce road accident fatalities by 80 to 90 percent by adopting these fundamental principles.

What measures have you put in place to achieve such cuts?

The biggest changes have been in road infrastructure design. Traditional road design aimed to reduce the number of crashes by widening and straightening roads. But that has no impact on the severity of injuries because vehicle speeds increase.

We aimed not to decrease the number of crashes, but to decrease the fatalities and serious injuries with traffic calming measures like roundabouts and elevated crossings. The body has crash tolerance limits; they should not be exceeded.

As soon as the driver loses control, the infrastructure should take over to mitigate the seriousness of the crash, for example by clearing trees and boulders from the sides of roads and installing side barriers; it is kinetic energy control.

What are the best ways to improve road safety by controlling that energy?

Barriers and roundabouts and design for pedestrians have been the most important. The idea of "shared space" between pedestrians and vehicles has been trialed successfully in Gothenburg and other cities, as long as the environment has been redesigned for slow traffic.

We have also adapted two-lane roads—real killers—into roads with two lanes in one direction and one lane in the opposite direction, the 2+1 system. But the real trick was a crash barrier between the lanes, which saves approximately 50 to 60 fatalities per year.

How much does this cost?

It costs around one twentieth of the investment in a new freeway, less than 200 Euros per meter compared to about 7000 Euros per meter to construct a new road. We have retrofitted about 2000 kilometers of road, covering about 20 percent of Sweden's traffic flow.

The new safety principle, to control kinetic energy, is by itself cheaper than accident prevention. And once that investment is made it produces benefits every year.

Furthermore, 2+1 roads have higher speed limits today than they did before modification, so by creating better safety we have also improved mobility.

Vision Zero tilts the balance of responsibility from drivers towards road builders and managers. Does it also shift legal responsibility?

You can't solve safety simply by placing a legal requirement on the user. Road users must follow the rules of the system but system designers— road managers, the auto industry, police, and politicians—are responsible for safety within the entire system.

Legislation that requires infrastructure providers to demonstrate road safety improvements is coming. It places quite a large burden on local and state government. However, it won't send road administrators to jail.

How has Vision Zero made vehicles safer?

The problem is safety equipment is often optional. We couldn't regulate as a single country in Europe, so we had to invent ways to get new safety features into the marketplace. Part of the Vision Zero strategy is to improve the demand for safety.

Electronic stability control (ESC) makes sure drivers don't lose control. It reduces crash fatalities by about 20 percent, second only to seatbelts in terms of in-vehicle safety measures.

We told occupational health and safety inspectors to make sure company fleets had ESC, we made sure all imported cars had it; we spoke to insurance companies about favouring ESC cars. Now 98 percent of new cars sold have ESC, the world's highest penetration rate.

We have also introduced seatbelt reminders in cars, and alcohol interlocks in commercial vehicles, taxis and fleet vehicles. In buses and trucks the penetration is around 30 to 40 percent and increasing rapidly.

Does Vision Zero mean Zero Tolerance for traffic violations like drink driving or speeding?

That is the other side of the coin. We will provide a safer road system but we also place a higher demand on road users.

The laws on drink driving have been strengthened. You are more or less sent to jail if found drink driving, and we have many random breath tests.

We need dialogue with the public to build social norms. With alcohol we have built a social norm—only 0.2 percent of the traffic stream is driving drunk. We have not yet created a social norm for speeding.

What is unique is that we are one of the first countries to change speed limits to conform to the crash worthiness of the infrastructure. So we have higher speeds on divided roads with barriers, but lower speeds on undivided roads.

What difference has Vision Zero made?

In 2008, 397 people died because of road traffic accidents. That is 4.3 fatalities per 100,000 citizens, probably the second or third lowest rate in the world, and around half the European Union average.

In 1997, the year Vision Zero was adopted, there were 541 road deaths in Sweden. We have seen something like a 30 percent drop in fatalities.

How could Vision Zero improve? What remains to be done?

Almost everything. The principles have been proven to work, now we are implementing them. The most dramatic change will be in the vehicles, both to support the driver but also to use the time between the driver losing control and before the crash. This is a second or two; an ocean of time to do quite dramatic things like braking and steering to make the vehicle more crashworthy.

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How can Vision Zero improve road safety?

Sweden legislated Vision Zero in 1997 - a philosophy of road safety that eventually no one will be killed or seriously injured within the road transport system.

Vision Zero provides a vision of a safe road transport system which can be used to guide the selection of strategies and then the setting of goals and targets. Zero deaths is intended as long term target. It is a change from an emphasis on current problems, to being guided by what the optimum state of the road transport system should be.

Traditional road safety philosophy is that the road user is responsibe for safety. There are general rules that the road user should behave so that crashes are avoided. If a crash does occur, at least one road user has, by definition, broken a general rule and the legal system can therefore act.

In contrast, Vision Zero explicitly states that the responsibility is shared by the system designers and the road user:
- road users are responsible for following the rules for using the road transport system set by the system designers
- designers of the system are responsible for the level of safety as provided by the design, operation and use of the road transport system - so are required to take necessary steps to counteract people being killed or seriously injured.

Vision Zero states that the loss of human life and health is unacceptable and therefore the road transport system should be designed in a way that such events do not occur.

This means that safety is as (or more) important as any other issue in the road transport system. Mobility therefore should follow from safety and cannot be obtained at the expense of safety.

For example in Vision Zero, speed is often used as an operational definition of mobility. Thus, Vision Zero states that speed must be limited to a level commensurate with the inherent safety of the road system. The safer the roads and vehicles, the higher the speed that can be accepted.

This is a true paradigm shift and contrasts to the more general principle, where human life, mobility and other benefits and problems are weighted against each other.

A first step would be to 'audit' current infrastructure-speed in terms of safety. This will highlight where it is most effective to either reduce speed or modify the infrastructure.

Best practice long term maximum travel speeds related to the infrastructure, given best practice in vehicle design and 100% restraint use may be:
- Locations with possible conflicts between pedestrians and cars - safe speed: 30km/h
- Intersections with possible side impacts between cars - safe speed: 50km/h
- Roads with possible frontal impacts between cars - safe speed: 70km/h
- Roads with no possibility of a side impact or frontal impact - safe speed: 100+km/h

Vision Zero is a long-term strategy in which the system and its use are gradually integrated and where the responsibility for safety gradually becomes shared by the designer and the user of the system.

~ Phil Charles

See: http://www.sei.se/visionzero/

Reference: Tingvall, C (1998) *The Swedish 'Vision Zero' and how parliamentary approval was obtained*. Road Safety Research, Policing, Education Conference. 16-17 November 1998, Wellington, New Zealand.