

VISION ZERO: APPLYING ROAD SAFETY TO AVALANCHE SAFETY

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ABSTRACT: In 1997 the Swedish Parliament mandated that road fatalities and serious accidents be reduced to zero by 2020. To achieve this extraordinary directive requires a radical and new approach to road safety. Called "Vision Zero" this innovative approach to road safety is a paradigm shift that views the loss of human life and health as unacceptable. Since the late 1990s Vision Zero has reduced Sweden's road fatalities by nearly 50%, and Sweden now has one of the lowest per capita traffic fatalities rate in the world, close to a quarter that of the United States. To achieve such impressive results has required a profound shift in traditional thinking about accidents, human behavior, individual responsibilities, economic costs, enforcement and education. Basically, Vision Zero requires the road transport system to be designed to prevent serious accidents from occurring. This paper introduces how the Vision Zero concept could be applied to avalanche safety to inspire the next generation's philosophy of avalanche safety.

KEYWORDS: avalanche, accidents, fatalities, road safety, Vision Zero, Sweden, United States

1. INTRODUCTION

The purpose of this paper is to introduce a novel perspective on road safety as a metaphor for avalanche safety. The information offered is not meant to be prescriptive but rather as a source of new ideas from which road safety concepts may (or may not) be applied to avalanche safety.

To make a comparison between road accidents, which involve all users of roads including vehicles, motorcycles, bicycles and pedestrians, and avalanche accidents is reasonable. Avalanches and traffic create hazards that pose significant risks to people. Avalanche accidents are similar to road/traffic accidents in numerous ways. Victims often cause their own calamities, but sometimes other people cause the accidents. Many victims whether on the road or snow have awareness and skills training. Many victims are experienced or are at least enthusiastic in their mode of travel.

There are also dissimilarities. While both the motorists/pedestrian and backcountry traveler have free will regarding where and when they travel, once the motorist is on the road he or she operates in an environment created and managed by other people. The backcountry traveler faces natural forces. Traffic accidents are societal disasters and viewed as a public health problem. In the US road accidents kill 1000X more people than avalanches, so considerable resources are spent to study to understand the problems so to mitigate road dangers and consequences. Avalanche ac-

idents are an individual's problem and receive very few resources to study, understand and correct or mitigate the dangers and consequences.

2. SWEDISH APPROACH TO ROAD SAFETY

Safety has always been an important part of Swedish culture, and traffic fatalities relative to their population have always been amongst the lowest in the world.

2.1 *History*

In 1990 the Swedish National Traffic Safety Program set a target of less than 600 traffic deaths by 2000. This initial goal was reached by 1994. But, transportation and safety experts, and politicians felt the numbers of deaths and serious injuries were still too high.



Figure 1. Road fatalities in Sweden from 1980 to 2010 (IRTAD, 2011).

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In 1997 the Swedish Parliament mandated that road fatalities and serious accidents be reduced to zero by 2020. To achieve this extraordinary

directive requires a radical and new approach—a paradigm shift—to road safety called “*Vision Zero*.” This new plan shifted away from the traditional road-safety thinking to one that views the loss of human life and health as unacceptable.

Since the creation of the *Vision Zero* program, several countries (notably Australia, Netherlands, Norway, United Kingdom, Slovenia, and Poland) have adopted the concept or significant portions of it as a part of their national road safety plan. Outside of Sweden numerous regional and local governments have also adopted *Vision Zero*. In the United States this includes Minnesota, Utah, Washington, Oregon, West Virginia and the city of Chicago. Also, the US trade organization American Traffic Safety Services Association adopted the *Vision Zero* concepts to be the key part of their mission statement, though they reworded slightly their program to “Towards zero deaths” (2008).

2.2 Successes

Traffic deaths in most countries have been decreasing over the past several decades. According to the International Traffic Safety and Data Analysis Group (IRTAD, 2011) the measure of *fatalities per billion vehicle-kilometers* is the most objective indicator to describe risk on roads (but does not take into account non-motorized travel.) Sweden has one of the lowest (second to Iceland) mortality rates in the world at 3.2 deaths per billion vehicle-km. The US ranks 13th with 6.8 deaths; Canada, 12th with 6.5 deaths (IRTAD, 2011). When comparing deaths per capita, Sweden’s rate is 42% of Canada’s, and 26% of the US.

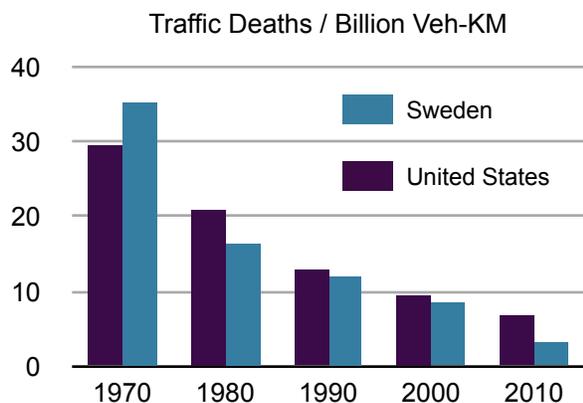


Figure 2. Comparison of traffic deaths in the US and Sweden, 1999/00 to 2008/09 (IRTAD, 2011).

In Sweden and many other locales the *Vision Zero* principles have been effective at reducing significantly mortality and serious injuries. However, in some locales results have been inconclusive and there are some skeptics who view *Vision Zero* as a “political gimmick,” a few are civil service economists, some others who think it to be a short-term goal to actually achieve zero deaths (Whitelegg and Haq, 2006).

Before explaining *Vision Zero* program a short review of traditional road-safety thinking is necessary.

3. TRADITIONAL THINKING

For generations and almost universally decisions on road safety have been decided by cost-benefit analysis (CBA). The course of safety actions taken for road safety followed a three-prong approach.

3.1 Cost-Benefit Analysis (CBA)

The cost-benefit principle says only to take actions whose benefits exceed their costs (Franks, 2008). The traditional perspective on road safety is a cost/benefit economic model where safety is provided at a reasonable cost balanced with mobility. CBA is viewed as a rational framework for information on costs, effects and benefits. According to the European Commission a CBA is often used to find solutions for societal problems that are not solved by market mechanisms (EC, 2012).

A typical definition of “mobility” in CBA is “expeditious movement” (or similar wording), which infers “speed.” Since CBA recognizes a balance of mobility and safety some level of deaths or accidents are acceptable, and in CBA monetary values are placed on deaths, injuries and property losses. Safety is viewed as function of mobility.

Another important condition of CBA is the behavior of the participants, called actors. CBA expects actors (who include motorists and pedestrians) will make rational choices.

3.2 Road Safety

The traditional view of road accidents is that accidents are usually the sole responsibility of the user (WHO 2004). Thus the policy taken for road safety (and avalanche safety, too) has relied on a three-prong approach: education, engineering and enforcement. Identified by Wilde (2001) in 1993 and labeled the “Triple E”, this policy seeks

to improve safety by enlightening participants, improving equipment and enforcing rules. However, as Wilde points out, this policy fails to take into account the motivations of the actors. Wilde does not deny the benefits of the Triple E, he highlights the problems and how and why the Triple E can lead to greater risk-taking that leads to greater accident rates and mortality. Others have recently heaped harsh criticism on the policy of Triple E. In a 2010 white paper authored jointly by the Royal Society for the Prevention of Accidents, Road Safety Great Britain, Institute of Road Safety Officers, Parliamentary Advisory Council for Transport Safety, and others wrote about the Triple E: "...not only limits the potential of road safety activity in terms of lives saved and underestimates the complexity of the issues being dealt with, but also prevents the development of key relationships across whole area policy plans."

4. VISION ZERO

Vision Zero is a visionary concept and is called a paradigm shift (Rechnitzer and Grzebieta, 1999) from traditional road safety concepts. The concept rejects the conventional trade-offs of safety, mobility and economics. Most revealing is its emphasis to move away from reducing accidents to moving toward eliminating the risk of fatalities and life-changing injuries.

There are four key elements to *Vision Zero*: ethics, responsibility, safety philosophy, and mechanisms for change (WHO, 2004).

4.1 *Ethics*

According to *Vision Zero* human life and health are paramount. The loss of life and health are unacceptable and therefore the road system should be designed to prevent such accidents.

4.2 *Responsibility*

Safety is a responsibility shared between road users to follow basic rules and road system designers (of highways and vehicles), enforcers (traffic engineers and police), and rescuers (emergency medical system). If the road users (motorists, bicyclists and pedestrians) fail to follow the rules, the responsibility falls on the designers, enforcers and rescuers to redesign the system.

4.3 *Safety Philosophy*

Vision Zero acknowledges that people will make mistakes, so accidents are inevitable. A system that combines people with heavy, fast-moving machines is unstable and complicated. Since ac-

cidents will happen no accident should be so severe to exceed the tolerance of the human body. Thus mobility is a function of safety.

4.4 *Mechanisms for Change*

Rather than seeing road safety as a societal problem, *Vision Zero* relates to the individual and their right to survival in a complicated system. The demand on the road system is for the survival and health of an individual rather than for the mobility of users.

5. CONTRASTING TRADITIONAL THINKING AND VISION ZERO

In addition to the four central elements described above, table 1 summarizes how *Vision Zero* differs from traditional road-safety thinking. Key differences have been addressed in the previous section; however, four other components—focus on fatalities, enforcement and education, risks, and the costs of saving lives—in table 1 need additional explanation.

Traditional Thinking	Vision Zero
focus on accidents	focus on fatalities and serious injuries
excessive mechanical forces on humans	reduce mechanical forces to human tolerances
perfect human behavior	accommodate human failings into designs
enforcement and education – regulatory driven	enforcement and education – market forces (demand) driven
individual responsibility	shared responsibility
people don't care about safety	people demand safety
reasonable risks	unreasonable risks
single strategy solution	multiple combined-strategies solution
risk reduction	risk elimination
saving lives is expensive	saving lives is cheap

Table 1. Contrasting principles of traditional road-safety programs and Vision Zero.

To not focus on accidents might seem blasphemous in the traditional context of safety. However, *Vision Zero* acknowledges accidents will happen,

so the philosophy is to reduce the mechanical forces in the serious accidents to a level tolerable to the human body.

The idea of “market forces” is that demand for education and enforcement be driven by demand or market forces rather than by regulatory forces. Whitelegg and Haq suggest the use of ISO standards (2006).

Traditional economic thinking in a CBA assumes that risks are reasonable even though roads can tolerate vehicles traveling well over 100 km/hr to be within a meter or two of one another. Or that a vehicle can travel at 100 km/hr to pass within 1 meter of a child. *Vision Zero* views these types of risks as unreasonable because the road system is unstable.

Prior to the mid 2000s CBA often held that saving lives was an expensive proposition. Using a term called “Value of a Statistical Life” (VSL) Government agencies tended to value lives low. When the VSL is perceived and calculated to be low the costs to save a life or prevent injuries can be deemed to be expensive. The values tended to be low because the calculations tended to be overly simple and did not include all the costs associated with the loss of a life (or incapacitating injury). (Section continues in the right column.) When the VSL values are perceived as high, then the costs of saving lives and the savings for prevention become very significant, especially when those costs are compounded over time. In the United Kingdom the prevention savings of *Vision Zero* have been estimated to be as great as £111 billion over 10 years (Whitelegg and Haq, 2006).

(The US Department of Transportation’s raised their VSL in 2011 to \$6.2 million (Trottenberg and Rivkin, 2011). To borrow the USDOT’s most recent VSL adjustment reveals that the economic value of last winter’s 34 avalanche deaths at more than \$200 million! NOTE: The VSL is not the real worth of a human life; it’s about the statistical money that the risk of death is worth to people who take on those risks (Goldlin and Merrick, 2011). The calculation of VSL is subjective, contains biases and is inconsistent across governmental agencies. Interestingly, countries that apply high VSL rates tend to have low traffic mortality rates.)

6. APPLYING ZERO VISION TO AVALANCHES

Just as one cannot control how one might crash one’s car, one cannot control the outcome of being caught in an avalanche. *Vision Zero* directs

the system to be prepared for all situations. Table 2 identifies and describes briefly what and how *Vision Zero* elements could be applied to avalanche safety. However, three elements: focus on fatalities, shared responsibility and multiple-combined strategies solution warrant additional discussion.

6.1 Focus on Fatalities and Serious Injuries

Instead of focusing on accidents *Vision Zero* focuses on the most serious accidents so to prevent fatalities and incapacitating injuries and can do this because there is extensive knowledge and certainty of road accidents. Because survival in any avalanche is uncertain, focus must still be on avalanche accidents; however, detailed study of avalanche fatalities and injuries are needed. Improved medical reporting will give insight to the pathology of avalanche morbidity and mortality. This will improve prehospital and hospital care. It will also better alert laypeople to the realities of avalanche encounters.

6.2 Shared Responsibility

Vision Zero shares responsibility. In terms of avalanche safety shared responsibility can take on many interactions between individuals, safety equipment manufacturers, land managers, resort operators, prevention providers, rescuers, and medical services. For example, in North America and parts of Europe, avalanche mitigation is performed by ski areas, but this is not the case everywhere. Effective mitigation programs reduce the avalanche danger to almost zero, but the danger cannot be eliminated. If resorts work to reduce dangers, then individuals have a responsibility to be searchable, so they can be found quickly. Electronic technologies can greatly assist organized rescue (ANENA, 2011) both inside and outside of resorts. In addition to transceivers and reflectors (to locate buried victims), individuals should also be equipped with technology to notify and attract rescuers so rescuers can come quickly and directly to their aid.

6.3 Multiple-Combined Strategies Solution

Traditional road safety, guided by CBA, seeks a single strategy solution. This “best practice” approach works in the presence of certainty, but fails in the presence of uncertainty. Prussian General Carl Von Clausewitz’s words on the condition of war also describe avalanche accidents, “...there is an interplay of possibilities, probabilities, good luck and bad that weaves its way throughout the length and breadth of the tapestry....” Because so

Traditional Thinking	Vision Zero	Comments
focus on accidents	focus on fatalities and serious injuries	The avalanche profession should seek more forensic and medical study of avalanche victims. Improved knowledge to the pathology of avalanche injuries and death will mean better prehospital and hospital care.
excessive mechanical forces on humans	reduce mechanical forces to human tolerances	Since a victim has no control over the forces of an avalanche there is little that can be done to reduce or limit mechanical forces. However, anecdotal evidence suggests that sometimes helmets and body protection may help in some avalanches.
perfect human behavior	accommodate human failings into designs	Rational choice theory does not apply to real-world human behaviors, especially when faced with hedonic decisions. More emphasis is needed on different decision-making strategies that help people think through decisions.
enforcement and education – regulatory driven	enforcement and education – market forces / demand driven	Peer pressure may be the best way to drive demand for enforcement and education. In the workplace regulatory control is generally unwelcome; however, it can bring legitimacy and increased professionalism.
individual responsibility	shared responsibility	Responsibility is shared beyond the individual. Also, the nature of rescue is changing and organized rescuers and educators have a responsibility to adopt an attitude that organized rescue is life-saving and not body-finding. An avalanche accident is a medical emergency, and companion rescue is generally not capable to care for or transport a seriously injured avalanche victim.
people don't care about safety	people demand safety	While safety is an illusion in avalanche terrain, many people do not seem to care about being properly equipped with avalanche personal protection equipment and rescue equipment. People cannot demand better PPE and rescue equipment from manufacturers (it's already very good), but people can demand of themselves and their friends to use the equipment.
reasonable risks	unreasonable risks	Much emphasis in recent years has been placed on risk management, but many people still seem to be taking unreasonable risks. More attention to uncertainty may help people be better aware of constitutes unreasonable risks.
single strategy solution	multiple-combined strategies solution	Unlike road safety, <i>Vision Zero</i> seeks multiple strategies and combines the strategies to find solutions. Since no technology (or device) is optimal all are embraced and it is the combination of strategies that produces the best safety outcome.
risk reduction	risk elimination	Risk elimination on roads is a possibility because—in theory—the system is only complicated (control inputs and outputs) and uncertainty can be effectively eliminated. Avalanche risk elimination is impossible in avalanche terrain because of uncertainty and a complex context (can control inputs but not outputs).
saving lives is expensive	saving lives is cheap	When considering the real costs of deaths and serious injuries, saving lives is cheap, especially when considering prevention. The avalanche profession should not focus only on losses but look to include VSL and value propositions.

Table 2. Comments on how *Vision Zero* principles might be applied to avalanche awareness. Outlined boxes represent potential for benefit to avalanche safety.

many factors must interact to have an avalanche, an accident, effect a rescue, and still survival is uncertain an avalanche accident and prevention should require the use of multiple and combined strategies to save lives. In *Vision Zero*, systems do not compete. They compliment one another. Technologies with proven functionality are combined. One solution, or device, is not dismissed for another. All technologies are embraced and used.

7. CONCLUSIONS

At first look, to apply *Vision Zero* principles to avalanche safety may seem impractical. *Vision Zero* seeks what the optimum safety state of the road system should be rather than the possible ways of reducing problems (Whitelegg and Haq, 2006). This goal confirms that road systems are manageable and certainty reigns. This may seem to be a mismatch with avalanche safety as avalanches are not always manageable and uncertainty prevails. However, there is congruence about road-traffic and avalanche accidents. Experts in both domains (WHO for roads; CAIC, KBYG, NWAC, SNFAC, etc. for avalanches) feel most accidents are predictable and preventable. Thus, parts of *Vision Zero* principles can be applied to avalanche awareness and may produce tangible benefits.

Vision Zero principles that can be applied to avalanche safety include:

- focus on fatalities and serious injuries
- accommodate human failings into designs
- shared responsibility
- unreasonable risks
- multiple-combined strategies solution
- people demand safety
- saving lives is cheap

The real benefit of considering *Vision Zero* to avalanche safety is that it requires a holistic approach and new ideas to reduce avalanche deaths and serious injuries. *Vision Zero* also questions conventional thinking and removes limiting biases and old-fashioned methods and attitudes. In essence, *Vision Zero* opens the minds of experts to think “outside the box.” No longer does one ask, “What can we do?” In *Vision Zero* one asks, “What else can we do?”

8. RECOMMENDATIONS FOR FUTURE WORK

The purpose of this paper is to urge interest in seeking outside means to improve avalanche

safety by looking to road safety for ideas and possible solutions. The United Nations has designated 2011–2020 as the “Decade of Action for Road Safety” (UN, 2011) so considerable amounts of information about good practices (multiple solutions) will become available in coming years.

For those interested, further work might include:

- Controlled implementation of selected *Vision Zero* principles with a process to measure the effectiveness of the actions.
- Collection and compilation of mortality and morbidity data of US avalanche victims to better understand the pathology of avalanche injuries and deaths.
- Calculation of VSL rates for avalanche victims.
- Review other road-safety programs like “sustainable safety” for possible application to avalanche safety.

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10. POTENTIAL CONFLICT OF INTEREST DISCLOSURE

- I, Dale Atkins, provide services to and receive compensation from RECCO AB.
- I, Magnus Granhed, am the owner of RECCO AB.