Vision zero: How it all started

Downloaded from: https://research.chalmers.se, 2026-09-07 02:54 UTC

Citation for the original published paper (version of record):
Tingvall, C. (2022). Vision zero: How it all started. The Vision Zero Handbook: Theory, Technology and Management for a Zero Casualty Policy: 245-266.
http://dx.doi.org/10.1007/978-3-030-76505-7_8

N.B. When citing this work, cite the original published paper.

research.chalmers.se offers the possibility of retrieving research publications produced at Chalmers University of Technology. It covers all kind of research output: articles, dissertations, conference papers, reports etc. since 2004. research.chalmers.se is administrated and maintained by Chalmers Library

(article starts on next page)

Vision Zero: How It All Started

7

Claes Tingvall

Contents

Introduction 246
So Where Is the Starting Point? 248
The Ethical Rules of a Road Transport System Provider 249
The Simple Model to Save Lives, Including Illustrations 250
The "Solutions" to Improve Safety 250
How the Initiatives Were Shown: The Tylösand Story 251
The Government Investigation and the Parliamentary Decision 252
The Crash Tests 253
The 2 + 1 Roads 254
The Australian Story 255
The Rhetoric and Illustrations of VZ 256
The Integrated Safety Chain 257
What Was Achieved and What Did Not Happen 257
The Criticism 259
The Society of Economics 259
The "Nanny State" and the Paternalism 261
Discussion 261
Reflections 264
Cross-References 265
References 265

Abstract

This is a presentation of how I remember the first steps of Vision Zero, the Swedish reorientation of traffic safety policy that took place from the mid-1990s and onwards. It is not an objective text that would be impossible to write as one of

C. Tingvall (✉)
Chalmers University of Technology, Gothenburg, Sweden

Monash University Accident Research Centre, Melbourne, Victoria, Australia

AFRY, Stockholm, Sweden

© The Author(s) 2023

K. Edvardsson Björnberg et al. (eds.), *The Vision Zero Handbook*,
https://doi.org/10.1007/978-3-030-76505-7_8

the initiators of the policy change. But it brings up some of the steps of the process and presents some hypotheses on how policy change might happen.

It is claimed that there was no planned process, not even an ideology or well-developed idea, behind VZ from the very beginning. But there were opportunities and events where one thing led to another. The most fundamental being the immediate acceptance from the Swedish Minister of Infrastructure back in January 1995.

The most prominent ideas behind VZ are that firstly safety is a matter of how the providers of the road transport system design and build and manage the system. The second idea is that a professional provider cannot trade off the citizens' life and health for benefits to the society and its citizens. The underlying hypothesis is that tradition and road traffic rules for the road users have been used as an excuse for not undertaking necessary system changes and modifications. The users have always been blamed for crashes and its consequences by the legal system as well as general approach from the society.

The last part of the paper reflects on what is necessary to do in the future to eradicate amateurism, populism, and trade-offs from the road traffic safety field. Maybe a "duty of care" legislation needs to be introduced, protecting the citizen from poor design and operations.

Keywords

Vision Zero · History · Ethics

Introduction

"Zero" was my answer to Lars Harms-Ringdahl when he asked me how many deaths would be the target for the design and development of our child restraints. Lars Harms-Ringdahl was a consultant that Folksam Insurance Group had hired to help with the quality management for the child restraint program Folksam had developed to protect children traveling in cars. Lars was a very competent consultant in safety management, and he knew what questions needed to be asked to the management. At this time I was responsible for the design and quality of the development of the child restraints, and the question asked by Lars was the first time for me. This was back in 1989, and I have been thinking of it since and asked myself the question if there was really any alternative to the answer I gave. I have come to the conclusion that I had no such alternative but that the analysis behind has deepened a lot. In 1989, I answered more from what my feeling said.

On January 26, 1995, I got the same question, but from the Minister of Infrastructure, Ines Uusmann. I had just taken up the position as Director of Traffic Safety, being recruited by the Director General at the Swedish Road Administration (STA). The whole management of STA was assembled to meet the Minister for her yearly visit to STA. The Minister had her staff with her, and she asked questions of different kind. She was also new to her job since September 1994. Her background was at

least partly from occupational health and safety, something that should prove important for the story.

Her question was simply: "How many deaths should we have as our long-term target in Sweden?" My answer was the same as in 1989: "Zero!" I can still recall the feeling in the room. It was quiet – it was everyone waiting for the reaction from the Minister. I had said something that was completely against the culture of a road administration and against the transport politics in Sweden and against any policy expressed by any road administration and parliament across the world. Zero would mean that safety would stand above all other factors building up transport politics and priorities. This was completely against the trade-off paradigm.

The Minister reacted, against all odds, very positively and expressed that this would be something she would like to hear more about. Anyone used to the life inside the bureaucracy within a state government understand what this means. It means that as long as the Minister will stay in office, what she expressed is protected. Any other answer from here would have killed the idea and probably led to immediate resignation from my position.

I was naive, but I also knew the background of the Minister. So I made the comparison to the workplace, where there is a clear line of responsibility and a clear expression of that trade-off between the effectiveness and profitability of the operations versus the life and health of the employees, is not allowed. The road transport system with its long history of just blaming the victims should be questioned. And mobility would develop as a function of safety, as safety would form the boundary condition for mobility.

That evening, the Director General came to my room and said, not aggressively or in a threatening way, that: "I don't expect a Director of Traffic Safety to stay any long time here if he talks about zero." It was simply saying that this would be expected to happen with such a radical and "impossible" statement in a culture that clearly express that lacking safety and other negative aspects of the road transport system should be weighted against positive factors like mobility and improved economic activity. Safety investment should be cost-effective and carry its own merits to be given green light.

My insights in seeing the road transport system as a real system with interacting components came late. It was in the beginning of 1995, before the meeting with the Minister, that I happened to pass a meeting room, where a researcher that I had known for long presented a study of the effectiveness of roundabouts in comparison with traditional signalized or non-signalized intersections. The results were simply astonishing. The roundabout decreased the risk of a fatality for a car occupant with more than 90% in comparison with a conventional intersection. But the effectiveness on crashes with only minor injuries was small, if any. First of all, this meant that the action taken by the road infrastructure provider has a fundamental influence of safety in terms of fatalities and serious injuries. Secondly, it all came together in that it was the combination between the ability of crash protection from the car in combination with the typical speeds and angles at impact that generated the results, not the fact that there were fewer crashes. This is maybe the biggest eye-opener for me ever in my career in traffic safety. We have a system where humans, vehicles, infrastructure, and energy all come together and relate to the human tolerance to kinetic energy –

the perfect match. Without this approach I am sure I would not have any chance to survive the next months after the visit of the Minister. She accepted the political framework, but everyone would follow up with the question on how it would be possible in reality to improve traffic safety at a completely new scale.

The insights I got from the short visit in the meeting room dealing with roundabouts were my own. I am sure many others already had that insight, and I must say that I felt a bit shamed by myself, looking at my research career before this insight. It really marks a completely new era for me. The insights about responsibility and scientifically based solutions suddenly fitted.

So Where Is the Starting Point?

The insights led me and my team to a very fast development of thinking. Roger Johansson, Lars Stenborg (today Eriksson), and I started to express this development in writing. And I checked and got inspiration from my network, Maria Krafft, Anders Lie, and Anders Kullgren, all through the process. We did the following analysis.

We need to move from the "blame the victim" approach to road crashes and casualties. In short, this is a matter to move from the approach of backward-looking responsibility to forward-looking responsibility or from a juridical view on the human and his or her action before a crash to the system design and its role to protect the road user from being killed or seriously injured. In even more simple terms, it is a matter of protecting the road user from his or her own mistakes, misunderstanding, and even violation of traffic rules. The failing human must be the norm for all providers of the road transport system. "Errare humanum est" must be our first sentence. It is human to make mistakes, and we must design for the human as we are, not the perfect human that in reality does not exist.

Very early, this first step led us to the number zero, by deduction rather than only a target that sounds ambitious or even revolutionary. Our simple translation of moral philosophy told us that, while every individual human is free to take risks, or choose to use the road transport system or not, the responsibility that would fall on the provider of the system. There would essentially be no excuses for anyone's loss of life and health. To have someone else's life in your hands is something completely different than just your own life. This is why there is no alternative to zero, although someone could question if zero is possible. We stole the ethical imperative to always put life and health above anything else from Hippocrates and the ethical rules of the medical community.

Vision Zero was a way to compare the workplace, aviation or railway, nuclear power production, or other activities and systems in the community that handle potentially hazardous operations but where the individual human would expect an operation without weighing his or her life to the effectiveness or profitability of the system. An employer is not allowed to improve the effectiveness of the workplace by risking the life of the employee. While this happen in reality, rules and moral philosophy would not allow it.

Many have seen Vision Zero as a true vision, a target, or even a strategy. In fact, the expression is the notion of responsibility for the providers of the road transport system. This is why the expression "Vision" came a bit later than "Zero."

The other step was to build a simple model of how to go about saving lives at a level never seen before by a national governmental body. Haddon had already shown the way! It was really kinetic energy that led to loss of lives and health. And to control, harness, reduce, cushion, or redirect harmful kinetic energy was the trick (Haddon 1970). It was just a matter of bringing all the components of "Haddon's matrix" together to form a system of protection and prevention. This had not been done before with the objective to eradicate the risk of death and loss of health. The starting point was the human tolerance to kinetic energy, and the end result was to have zero deaths and serious injuries – simple in theory, very complicated in practice.

One of the first misunderstandings was that we looked for "passive" solutions, in those days meaning crash protection and not crash avoidance. So the challenge was to describe prevention as a chain with numerous possibilities to stop the crash, change the crash, or mitigate the consequences of the crash.

The third step was to "develop" a number of proposed initiatives that would increase safety significantly. The main idea of these proposals was that they would be directed towards the providers, not the road users. The idea to first say that we as providers have an unlimited responsibility for human life and the turn to the public and tell them to behave better was considered impossible and even counterproductive. At the same time, it was essential to show what Vision Zero would mean in reality, and not just as nice words, to both politics and the public.

The Ethical Rules of a Road Transport System Provider

A new framework for responsibility, moving the main responsibility for future safety from the road users to the providers, is no doubt very challenging. And the challenge is not only structural, in what it would mean for road user rules, legislation, and democracy, but also from a moral point of view. Very early in the process, we noticed that many reacted to the expression "moving the responsibility from the road users to the system providers." In essence the reaction was moral: "maybe the citizens will start behaving without any sense of responsibility. . .?"

Our thoughts went more in the direction of "ethical rules" rather than new legislation. While legislation towards the providers might be an issue in the long run, our ideas were directed more towards the mindset of the ethical rules in medicine and health care or the guidelines for engineers. We came up with five ethical standpoints (Tingvall et al. 1996):

1. One must always do everything in one's power to prevent death or serious injuries.
2. The right action must always be taken from the very beginning, i.e., all action taken must rest on scientific, tried-tested experience.
3. The best-known solution must always be applied.
4. The factor that ultimately governs the decision to change a situation must be both the risk and potentially harmful effects of an existing situation.

5. Work must always be based on the fact that the responsibility for every death or loss of health in the road transport system rests with the person responsible for the design of the system.

While the original expressions above might not be optimal today, they would still be relevant. The first ethical "rule" reflects that safety cannot be traded off to mobility or any other benefit. The second is really that all actions must be evidence-based. The third is really that given the circumstances and available resources, the most effective solution must be chosen. The best example would be to apply a speed limit setting regime that would be based on safety.

The fourth "rule" would simply mean that both risk of a crash and its consequences should be in focus – this as a reminder that VZ is not a crash protection policy, but an injury prevention policy.

The fifth "rule" is really pointing at mandatory crash investigations concentrating on system design and defects, rather than a road user approach trying to find the guilty person.

The Simple Model to Save Lives, Including Illustrations

Our simple model for eliminating death and serious injury was a dose-response relationship between energy and risk of death and serious injury (Tingvall and Lie 1996). The energy would be the most relevant parameter for each road user category and crash type. But in the end, it was really what speed limit over ground that we in the long run would be able to handle without risk. For pedestrians it would be 30 km/h and for car occupants 50 km/h in conventional intersections, 70 km/h for roads without median barrier, and 100 km/h or more if the road had a median barrier. The boundary conditions for the vehicle were "four stars" (maximum crash protection), the occupant in the car must wear seat belts, and the driver must be sober and drive within the speed limit. It was a sort of a cross-condition model, and it was presented already in 1995. Of course it had its problems with validating if it would hold in reality, but it was a clear message that mobility was a matter of safety design; higher speeds could be the result of a safety improvement, meaning that investments should be going to safety, as this would mean a better mobility in terms of the conventional time saving optimization. I never felt this was a complicated relationship, but for unknown reasons it took years for transport planning to grasp this, and still seems to be.

In any case, it meant that if a higher speed than 70 km/h should be allowed, the road must be divided. This was a chock for some, but we "invented" a solution to that.

The "Solutions" to Improve Safety

It goes without saying that presenting a radical idea without showing at least something that would make it possible would be detrimental to the idea. So we had to show something, and it had to be quite radical but possible. While we were

clear about that a complete "plan" for VZ would not only be impossible to do at this stage, we even tried to claim that we should leave the whole idea of innovation to the community to develop. But in any case, we had to show something. So we made a short list of things that we were quite clear about. Strangely enough, the most radical was also the simplest. It was the 2 + 1 road with a physical median barrier. It was not really an innovation; a 5-year-old child would come up with this immediately if you would ask for a solution of eradicating high-speed frontal crashes. The overall idea about dividing traffic was old, and in a report from VTI, the Swedish National Road and Transport Research Institute from 1991 showed how 13-m-wide roads could be divided by a concrete barrier. What we did was to demonstrate our knowledge about car safety and combined a narrow flexible barrier with a 2 + 1 design: a low-cost and really "safe" solution. But the road designers really hated the idea from the beginning, and how would we know that it worked?

We also suggested intelligent seat belt reminders in all new cars (seat belt use among killed car occupants at that time was below 30%), alcohol interlocks, safer cars, and all intersections built as roundabouts and a maximum 30 km/h in areas where cars and unprotected road users would be mixed. That was it. Today it would be mainstream, but in 1995 it was very radical!

How the Initiatives Were Shown: The Tylösand Story

The real test for the ideas took place at the Swedish Annual Traffic Safety Conference in Tylösand. It was not really a plan, but I had prepared a number of slides (at that time overhead slides) with most of the thoughts we had at the time. My presentation was really going to be about management of traffic safety and the new National Road Safety Plan. But in the morning before the presentation, I decided to show our thoughts and ideas instead. Being the Director of Traffic Safety at the Road Administration, what I said was the official policy of the STA. And the Director General and all the regional directors of STA were there, sitting in front of me.

This was the most risky situation in the whole sequence. To present something that sounded like a whole new policy from the national body, without any internal process in advance, should not be possible. But this was the chance. I understood that there could be no open criticism from the management of STA, and if things went well with the presentation, that would protect the ideas for a long time, although I might lose my position. I was willing to do so. But I also felt that I had legitimacy from the Minister of Infrastructure.

My presentation went very well, media reported, and the ideas landed the way they should. We had presented not only a new framework for responsibility but also how it could be done and new processes and solution. One idea that became popular at once was that we planned to make an in-depth system study of all fatal crashes in Sweden, looking for what we as system provider could do in the future to prevent all fatalities. And the first ideas about 2 + 1 roads were presented.

But the regional directors at the Administration were not happy. In fact, they were not happy at all. They were not necessarily against the ideas, or rather not all of them,

but they were upset since I had not asked their "permission" to present a new policy. Today, I fully understand them, but I can also see that VZ would not have happened unless I had broken the rules of the system – at least not in Sweden.

It was the new Director General for STA, Jan Brandborn, who protected me and supported us in developing the concept. While he was not in favor of all individual ideas, he liked the way we moved forward and was proud to have a team that was trying to be in the forefront. He even asked me to build a new traffic safety department at STA a few months later. And we did!

During the autumn of 1995, we had the opportunity to deepen the ideas and, as so many were interested, to present the ideas to many stakeholders. The support started to grow and so also the forces against.

I was allowed to recruit Anders Lie as responsible for building up an in-depth crash investigation organization. The idea was to look for the opportunities to partly find what we as an organization could have done to save every life lost and partly to educate our organization what professional prevention was all about; to emotionalize our management not by feeling guilt, but to understand the tragic behind every fatality; and to understand that it could happen to anyone. Crash victims are just normal human beings, sometimes doing quite stupid things, sometimes doing very small mistakes. The in-depth studies of all fatalities in Sweden were to be presented to the regional directors and their management teams. This was a very large step forward.

The Government Investigation and the Parliamentary Decision

In record time a governmental investigation of traffic safety was assigned. The main writer, Johan Lindberg, undertook to describe the background, the content, and the consequences of VZ as well as proposing decisions to be made by the Parliament, the Government, and Local Governments. Most of the ideas for the future were there when the investigation was launched in early 1997. The most far-reaching point was the proposal for a new line of responsibility. It was said that the provider was ultimately responsible for the safety and the road user for following rules and regulations. The most striking and unusual sentence was, though, that if the road user failed to follow rules and regulations, the responsibility would fall on the provider to come up with new solutions. This last sentence was really controversial, and before the investigation was published, this sentence was included some days and not there some days.

Another very important sentence was that the speed limits were to be set based on the safety standard of roads and vehicles. A higher standard would mean that a higher speed could be allowed. Formulated in this way, none would be against the idea, and this sentence survived and could be picked up later. This was really the fine art of authorship in the state policy area: to formulate clever sentences that would be able to survive and be used in the steps to come. Johan Lindberg was a master in this art, with some good help from Lars Stenborg.

The investigation went for circulation among different stakeholders and generally got positive comments. The most striking negative comments came from VTI, the state transport research body in Sweden, claiming that VZ would be in breach of the balanced development where different qualities were weighted in relation to each other. VZ would be a suboptimal use of the societal resources according to VTI.

The Swedish Parliament voted for VZ in October 1997, and all parties were in favor. One party had a minor alteration of the proposal, but in essence all were positive. No political party or any Minister of Transport has ever openly questioned that decision since.

The whole sequence from the presentation of the first ideas in 1995 to the decision by the Parliament in 1997 must be a "world record" in policy change. I am not sure all members of the Parliament understood what they decided, but I am sure enough many knew to say that the decision was legitimate. The texts from Johan Lindberg stood the test, and most of it survived the whole way, including all relevant parts.

The Crash Tests

The attempt to improve vehicles and road infrastructure as main objective in the first phase led us in many directions. One of them was to find ways to make car industry to compete on road safety, in modern terms to bring car safety to the market. For many years, car safety was led by regulation. But the regulation had been bypassed many years ago by research and knowledge to go far beyond current standard of mainstream cars. A new EU regulation was on its way, and this was a chance to use the new tests of crash protection to compare new cars on the marketplace. Something similar had happened in the USA in the late 1970s with good results. And Australia had started on the same journey in the early 1990s. So now it was time for Europe. The UK had already made some tests at TRL, their national test laboratory, and we knew they were keen to publish the results. But they were reluctant as it would be a tough journey for them to tackle the anticipated criticism from the car industry – and to do that alone. So we contacted the British Ministry of Transport and asked if we could support publishing. Their answer was simply yes, if our Minister would openly back the initiative and if we could fund a second row of tests. Our Minister supported the idea, keenly, and we said yes to fund the second row of cars, this time mid-sized cars.

The first set of cars were superminis, and the resolution was not great. In fact the results were more like very poor cars compared with even poorer cars. The worst of them all, the Mini (still in production in 1995 under the Rover badge) was never published, for quite obvious reasons. I saw the crashed car several years later, with the crash dummy still inside as they could not get it out without completely destroying the car.

The second row of cars was published later, and the results showed a much larger resolution. And the good news was that there was a four-star car, something industry said was impossible. And the manufacturer, who happened to be Volvo, could not resist to tell the market they were the best. And from that moment, the competition

started. Euro NCAP, the consumer safety rating system, was born, and more members came on board. And it has given us more than what we ever could have hoped for. Studies and analyses have shown such large differences between "old" and "new" cars that give us a real hope for progress also in the years to come. And industry policy statements that Euro NCAP was the wrong way to go and that there was not much potential in further safety development (yes, this was officially declared by the Association for European car manufacturers spokesperson in front of the EU Parliament) have been proven wrong on and on again.

A year later, STA decided only to buy and rent cars with top ranking in Euro NCAP – good news for those car manufacturers with high ambitions. But as we combined the safety ratings with fuel consumption, both Volvo and Saab got furious. Maybe not the most useful reaction as they told the public at the same time that their cars were thirsty for petrol. And the Minister for Environment and the Minister of Enterprise also got in open conflict over if a state administration was able to choose cars on the basis of safety and environmental performance. Our Prime Minister had to decide, and he declared that STA could of course choose cars. And of course many other stakeholders copied our requirements.

Since then, actively informing and acting on the marketplace for vehicles have been a real cornerstone of safety management. And to support the market penetration of new and very effective safety innovations like ESC or AEB is a given success. And to also bring solutions to the marketplace that really would not happen by itself, like intelligent seat belt reminders, has been instrumental through the Euro NCAP mechanism.

In 2008, Volvo Cars declared that they by 2020-year model would have zero deaths and serious injuries in and by a Volvo. This was a major step, although also Mercedes-Benz and Toyota had declared the same thing, but with no year given. Volvo seems to fulfill their target, at least for deaths in their "own" car. Many thanks to Anders Eugensson at Volvo Cars for getting this vision through the management at Volvo Cars!

The 2 + 1 Roads

The divided road with a barrier or simply just space has been known to be much safer than an undivided road for almost 100 years. The German Autobahn was the first attempt to apply the principles of the divided road with no intersections, no pedestrians or bicycles, and no slow-going traffic. So it was no real invention to use the same principles but packaged in something smaller and more narrow, like the Swedish undivided 13-m-wide roads built in the 1970s and the 1980s, over 4000 km, with high speeds and horrific results in terms of fatalities and serious injuries.

We developed the idea to modify the 13-m-wide roads to a 2 + 1 design with a very narrow barrier. At that time, the best alternative was the flexible wire rope barrier. And with the section 2 + 1 where we changed from one to two lanes every 1–3 km of road length, the possibility to overtake other vehicles was in fact better than for the

undivided road. But the resistance to trial the 2 + 1 road was solid and widespread. We could not find any project leader within STA, so we had to bring in a retired road engineer, and much of the job was made by Hans Wahlström as one of the members of my own team. And when we asked citizens in the neighborhood of the road we had chosen for our trial, only 0.3% was positive. And most newspapers, NGOs, and road infrastructure entrepreneurs were also against. But we were successful in getting the support from the Director General of STA, although he was lukewarm and made it clear to me that he was not willing to take responsibility if something went wrong. That was something I had to do, and in fact I accepted that thankfully.

Our preparations were comprehensive and serious. We knew that a crash into the barrier with a passenger car would not harm the occupants as the acceleration levels would not be high enough. The threat would be a motorcyclist hitting the barrier.

We managed to build the first 2 + 1 road outside the city of Gävle, and it was opened in June 1998, just 3 years after the first ideas. I had to open the road, as no regional director or alike was willing to go there and show their support. Media came and asked only questions about our plan when the first serious crash happen.

A couple of weeks after the opening, several crashes into the barrier had already occurred, all with no injuries. We even got a cake from a person that had crashed into the barrier. She was clear about that she would not be alive if the barrier would not have been there. She thanked us for her life, and that was the turning point for the 2 + 1 road. Since then, the support started to grow, and just a year later, more than 80% of the Swedish population wished more of the 2 + 1 roads. And STA started to plan to roll out many more such roads. And later, it was shown that the 2 + 1 roads lowered the risk of fatality more than 80%. For a very small amount of money and with the possibility to maintain a high speed limit of 100 or 110 km/h. In total we must have saved more than 1000 lives since the first opening in 1998.

The Australian Story

In 1998, I decided to leave STA and take up the position as Director and Professor at Monash University Accident Research Centre in Melbourne, Australia. I was quite worn out from my work at STA, and it was time to do something different. And MUARC was one of the most famous and successful research centers in the world.

Australia, in particular Victoria, had a quite good track record in traffic safety, driven by research and serious follow-up of initiatives. But it also had a road user-centric approach and a high level of police enforcement. I found this interesting and in sharp contrast with Sweden and VZ.

As MUARC was contracted by VicRoads, the road administration in Victoria, as well as other major organizations in Victoria, I very quickly joined the network and the strategy and tactics development. And of course many were interested in the Swedish policy development with VZ. After a while I got invited by Eric Howard, the talented and enthusiastic Director of Traffic Safety at VicRoads. He wanted me to meet and present for the CEO of VicRoads. The CEO listened and immediately hated the whole idea of Vision Zero. Eric, analyzing the situation and

needs for progress in Victoria, came up with a new name for VZ (or someone in his staff) that is less provocative and with less risk of being confrontative with his CEO and alike. The new name was Safe System – identical to VZ but framed in something more likable for many. Since this time, VZ and Safe System are synonyms, but of course each country and each organization have its own way to progress the principles and solutions. Tony Bliss, at that time working for the administration in New Zealand, picked up the ideas very early as well and helped to develop the ideas worldwide.

The Rhetoric and Illustrations of VZ

From day 1 we tried to find ways to express ourselves in a way that would stimulate thinking, debate, and reconsideration on earlier approaches. I am well aware that many got quite upset, and some felt even attacked. Sometimes I would be too harsh on earlier work or design of road infrastructure. One particular moment was a crash outside Stockholm with five deaths, all young. The car had probably aquaplaned and hit a concrete foundation to a lamp post. A concrete "barrier" just beside the most busy road in Sweden is no good idea, and while none could blame STA for the deaths of the five car occupants, it would be in line with VZ to stop using such design solutions and of course not replace the damaged lamp post with its concrete foundation at the crash location. The then Regional Director of STA claimed that not replacing the damaged post and foundation would indirectly mean that we blamed ourselves and that this would be a trauma to the regional staff. I might have reacted a bit too strong to this argument, and the idea to replace the concrete foundation with an identical one was simply abandoned. Later, I have understood that the feeling of responsibility for deaths might occur in an organization even if this is not the intention at all.

The most useful sentence or rhetoric question we would ask in the beginning was simply "how many deaths on the roads would be a reasonable number?" or even a bit sharper with "how many child deaths would be acceptable per year?". Any sensible person would answer "zero." Among the political parties in Sweden, none dared to discuss anything else than a zero long-term target or goal with the apparent risk of being accused of being cold hearted.

The favorite illustrations would be "the Jilg" drawings. Karl Jilg is a Swedish artist who was commissioned by STA to make four illustrations of turning kinetic energy (i.e., speed) to height. They are really brilliant and used extensively to explain the consequences of simple human mistakes and how wrong the design of the road infrastructure was. The rhetoric around the drawing was: "Has anyone ever met a perfect human?" They are still in use to demonstrate the odd distribution of space and security in urban settings and the consequences of simple human errors (Lindberg and Håkansson 2017).

The favorite rhetoric sequence about responsibility and who has the main role was the comparison between the signalized intersection and the roundabout, the latter having more than 90% reduction of fatalities, and the most risky situation being

the road user by mistake running a red light. So the following question would be: "Who has the main opportunity to reduce fatality risk at an intersection, the road users or the provider of the intersection?"

The Integrated Safety Chain

Our first models for a safe system were static that had no dynamic sequence for a crash and the exchange of energy. They also lack an integration between pre-crash and crash criteria. For me, the insight of bringing together pre- and crash factors and start looking for new opportunities came with a meeting with "Mr. Safety" at Mercedes, Rodolfo Schöneburg. It was around the millennium shift, and it gave the first glimpse of what was going to come in terms of pre-impact braking, etc. To me, it was really the next eye-opener after my understanding of the relativity between the vehicle and the road infrastructure, and it was the answer to the future and how to get to zero. Braking before impact is the big answer to the relation between travel speed and impact speed, and 1 s of braking, in theory braking 36 km/h (1 g during 1 s), would be worth as much as the whole area of crash protection. Seat belts and better vehicle structure have given us something like 35 km/h better safety, and now we were approaching a new major step in the history of traffic safety. And to also brake for a pedestrian or a bicycle was the answer to so many issues in urban traffic. We have not used the potential yet, but we are no doubt on the way.

The integrated safety chain makes no difference between pre-impact and impact countermeasures, and it is the way to see how different technologies come together and become the precondition for the next link in the chain. A pre-impact braking makes the crashworthiness more effective. But it also puts the driver and his or her condition in the right spot. And it creates the natural question to the automotive industry how they can make sure that the driver is fit, not speeding or driving aggressively. This was the starting point for what technology should do in supporting the driver as well as limiting the drivers' intentions if necessary.

What Was Achieved and What Did Not Happen

It is always more or less impossible to predict what would have happen if a certain process or decision would not have taken place. In the case of VZ, one might suggest that many of the initiatives taken could in fact have taken place without VZ. But most of what was predicted and necessary has happened and much more than this. The 2 + 1 roads, the 30 km/h speed limits in cities, the state policy to only buy and rent safe cars, the intelligent seat belt reminders, etc.

It is easier to find those proposals that did not happen. And there are in my view mainly three things that still seem to be hard to implement. The first one is the ownership over speed limits. It has been one of the cornerstones of VZ from the very beginning to control kinetic energy, by speed. Setting speed limits is therefore the most important decision to own, as any combination of infrastructure design and

vehicles could be catered for. But still today, speed limits are set on the basis of several factors, like mobility and time savings, although this is exactly what is banned under VZ. And decisions are still taken in a political context, while in fact they are technical decisions. No one would dream of letting the Parliament set the speed limits for trains, or maximum load weights for bridges, since they are technical limits. Regardless of how hard it may sound, democracy does not stand above physical laws.

There are guidelines for speed limits in the early VZ texts, and in Sweden there is a long-term plan to follow the guidelines set up in 2008 about speed limits in relation to cars of the future, but still decisions are taken outside the safety culture, in Parliament, and by the Government. This is of course not acceptable.

The first attempt for a global speed limit is the recommendation given by the Academic Expert Group for the Third Ministerial Conference 2020. In one of the nine recommendations, 30 km/h is the highest speed that could be acceptable where active road users are present. It would be quite odd if someone would argue against and on what basis that would happen.

The second is the technology that would stop driving under the influence of alcohol. It is without doubt a very complex issue to equip all motor vehicles with a technology that is only relevant for a few and to force each citizen to undertake a test with a breathalyzer each time the vehicle is started. In reality, it is not possible unless it is a vehicle used for certain types of transport, like buses. So there is a real challenge to develop a technology that is safe, nonintrusive to the sober driver, and still not possible to manipulate. The real trick is to drop the legal limit for intoxication by the technology and concentrate on stopping a trip that seems to be performed by a driver that drives as if he or she is intoxicated. This would open up for many solutions.

The third is also a fundamental issue. Since the late 1960s, the Vienna Convention has been used by many countries across the world. This convention is the basis for national traffic rules. In doing so, it has a central role in norms, insurance claim practices, and the division of responsibilities in the community between the road user and the provider of the road transport system. It has produced and distributed a set of rules that no doubt are simply impossible to follow. Article 13 in the Vienna Convention on Road Traffic, Rules of the Road, stipulates a rule that in every country the driver be able to stop his vehicle within his range of forward vision and short of any foreseeable obstruction. This rule is simply impossible to follow, in particular in combination with other rules of not hindering or disturbing the traffic flow. To have central rules that are not possible to follow would in any organized system be banned and removed.

It is even more sad to see the complete lack of "road rules" for the providers of the road transport system. Not even vulnerable road users, like pedestrians or bicyclists, are protected by any obligation for the providers.

Another issue where we failed miserably for many years was the ambition to stimulate the transport services to improve their safety and to manage this by self-regulation. Already in early 1996, we started to develop the ideas on how organizations could act as responsible citizens, both in procurement of vehicles and transport

services and how the market would react positively. It worked well for vehicles, but it did not work for transport services. Taxi transport, public transport by buses, and goods transports were all exposed to a marketplace that at least in saying expected that safety would be a prime parameter. But it seems more or less nothing happened. Taxis are still driven above speed limits, and it seems to be the same for goods transport. We learned by all mistakes we made, and maybe today, we can expect market forces channeled via improved sustainability records might work. But it is still hard to understand why the normal chain of delivering service or products, where every link in the chain would have to deliver without "defects" to the next link, has not taken place for road transport. This is a more or less mandatory "rule of the game" in the professional world that no one needs to check "incoming goods" to find defects, but even in logistics chains for industrial production, driving above speed limits and alike seems to be normal.

The Criticism

No doubt, there was criticism from the very start of VZ. Some would be related to the process, some would be misunderstandings or misinterpretations. However, some would be more fundamental and worth considering seriously. I have tried to pick these and comment on some.

The Society of Economics

No doubt, the most serious criticism came from the socioeconomic society (Elvik 1999), and they were both vocal and had many years of major influence. The planning of investments and activities within the road administration as well as in the Government was based on cost-benefit and cost-effectiveness approaches (SafetyNet 2019). An approach based on setting boundary conditions for one of the core factors in road transport would be against this paradigm and even against the transport policy as expressed by the Parliament. Added to this, it was claimed that it was against the core philosophy of decreasing marginal benefits, meaning that the socioeconomic cost of saving lives would be gradually higher as we would approach zero fatalities. Therefore, it would be detrimental to both the transport system optimization and mortality as a whole in the society if one factor would dominate and be funded at all cost.

The economic arguments are no doubt valid, if the background facts were adequate and true. We argued against saying that (1) human life is another dimension than transport effectiveness. It would be comparable to let the economic margins of a corporation be weighted against occupational health and safety. And (2) if we manage to save life at a gradually lower cost, the argument of decreasing marginal benefits would fall. And this would happen if we invented new methods rather than applying just one method.

It became clear after some time that the real difference between the standpoints of the economic society and the VZ proponents could be found in the basic analyses of the traffic safety problem. The conventional analysis concentrated on the individual as the agent of the economic burden to the society. The collective economic burden would be lowered with cost-effective prevention, but in the end it is the road user that takes his own risks. The collective demand for improvements would be channeled via the willingness to pay by the citizens and the revealed acceptable risk being measured by the fact that citizens used the road transport system. Improvements would only be defendable if the benefit was higher than the costs or at least the most cost-effective method used. There was no internal criticism to the basic analysis as we understood at that time. Not even the way injuries of different severities were weighted in relation to each other. In the socioeconomic principles, many minor injuries could be more costly than a few serious injuries or even deaths. VZ would not do so but instead have one threshold for injury. The threshold was deaths or an injury leading to a long-term health loss. In reality, we should not overestimate the importance of this change in how different injuries were prioritized. But in theory the difference is substantial and led to a new way of collecting health data from hospitals, while crashes with only vehicle damages were not counted at all.

We, on the other hand, claimed that the citizen intrinsically has the right to life and would not trade his own life and health to someone else's benefit. We claimed that the individual road user was in the hands of the providers and that there is a special responsibility that comes with this role – and that this was the dominating view and roles in other parts of the society and that the road user is more or less forced to use the road transport system in contrast to the economic theory saying that the use of the road transport system is voluntary and that the risks associated with using the system are widely accepted. As a consequence we should apply the principle of setting a predefined acceptable risk. And this risk must be close to zero, as it is in other parts of the society.

The discussion would sometimes be quite vocal, and too often it became a matter of ethics and moral philosophy rather than going back to the basic analysis and the role of the provider depending on how we judge responsibility.

Personally, I am puzzled that the old economic models are still in use, where time savings and loss of health are weighted against each other. Traffic safety, clean air, noise, climate, etc., are all boundary conditions for mobility but still seem to be prized and used in the weighing process.

The price of saving lives has dropped substantially over the years, and the economic theory has in this case been falsified. A great example is that the result of the economic investments in 1995 was one life saved per year by three billion Swedish Crowns. Five years later, it was 10 times better, 1 life/year saved/300 million investment. And it became even better by time. And for cars, the safety improvements that have been extraordinary have not meant that cars are more expensive. The industrial logic meaning that the costs for achieving a certain quality are reduced seems to be true also for safety. This is something we all need to understand better in managing progress in traffic safety.

The "Nanny State" and the Paternalism

From time to time, there has been a discussion of VZ as really an another policy of state paternalism, where political and administrative decisions could be taken and force individual citizens to act against their will. The discussion in itself is not new; it has been there for a very long time. We heard it when seat belt legislation was discussed, and it is still there when different ways to increase bicycle helmet use are compared. And it is a healthy discussion in a democracy. Where are the limits for the collective to force the individual to act in a certain way? And of course the answers from the citizens vary in time, and often it takes years and decades for attitudes to change. At the same time, we have examples of individual actions that are prerequisites for effective solutions. Many safety technologies in a car are far less effective if the seat belts are not worn. And investing in road design means that the effectiveness is higher if we can control speed. So it is not trivial to mix individual behavior with societal investments and action, something that kept Bill Haddon at NHTSA busy. He developed the ideas of active and passive safety, when these words had another meaning than today. Active meant safety that had to be "activated" by the individual. Conventional seat belts are active. Passive safety would be solutions that would be there irrespective of the individual, like airbags. Haddon's theory was that passive was more effective, more equal across the citizens, and easier to implement. Once again, this is an ongoing process in the community where technology and passive solutions are easier to accept than intervening in the "freedom" of the individual.

But there is, at least in Sweden, in my view a strange discussion about how far we should go in protecting the individual, as if there was a mechanism that made us mentally different and even mentally disordered by improved safety. It has even been presented as a scientific idea by a psychiatrist (Eberhard 2006) that we suffer from a collective security addiction. While it is not possible to find any scientific background to this "diagnose," it has been picked up in the debate. Personally, I think this is the best example of "Münchhausen by proxy" but on a level seldom seen before where a psychiatrist in his examples give the advice to limit the use of bicycle helmets to avoid the development of the safety addiction. Münchhausen by proxy is a diagnosis where a caretaker invents a disease or mental disorder in order to treat the patient or expose the patient to unnecessary treatment or potentially risky and painful treatment. To my surprise, even serious media and the large newspapers have picked up the idea about safety addiction. There is a risk that such approaches mixed with the "risk compensation theory" that never was validated either become a serious problem for a safety progress or open up for ideas that are just populistic.

Discussion

The Vision Zero was never a planned process. This is probably the most important characteristic of a major shift in this policy, and it must be stressed in a discussion on how it started and developed. I would rather characterize VZ as simple step-by-step

sequence using opportunities added with random events. There were no doubt a number of characteristics of the VZ included from day 1. But they were all separately already known and expressed before, either as arguments in road safety research and policies or from other sectors. But in combination they were new or at least novel as a policy (Belin 2012). The ethical standpoint leading to the "zero," based on a shift of responsibility from the user to the provider, is "stolen" from the occupational health and safety sector. And the ethical rules were essentially borrowed from Hippocrates and the ethics in medicine and engineering. But the rationale for applying them in road transport was new. And the driving mechanisms for change, that is, the citizens' right be safe instead of the road user to be blamed once a victim, was a new application of the classical three-party ingredients of prevention (the host, the agent, and the environment that brought them together). And being led to that safety is something we demand and should not be seen as a burden or restriction.

Finally, the use of kinetic energy as the main ingredient to control injury risk was really borrowed from Bill Haddon, but we developed his different prevention strategies to one model for boundary conditions based on the human tolerance for mechanical force. One could say that this was invented already by Hippocrates, but we brought figures and a systematic modeling to it.

The most important ingredient was, however, that it became known to the political system as an alternative to conventional transport planning based on socioeconomic models. Here was the real contrast and where things were brought to new discussion level. And once again, this was all a matter of circumstances. Maybe it would have happened anyway, and most certainly it would happen today, with sustainability as the new planning paradigm just around the corner.

What took years to understand in an institutional context was the shift from safety being a burden or restriction to mobility to that mobility is a function of safety (Tingvall and Lie 2017). An improved safety is the key to improved mobility. Normally, we can understand this for railway, or a workplace, but it has taken a very long time in road transport. It was maybe the most important sentence in the bill that went to the Swedish Parliament in 1997 when the final decision to adopt VZ was taken. In any case, this opens up for investments in safety seen as investment in mobility. And to see that, a separate "safety budget" is not necessary. An example was the 2 + 1 road, where the investment of modifying the road from undivided to divided meant that the speed limit could be 100 km/h or higher instead of 70 km/h. But what some had a problem to understand was that the speed limit would actually be 70 km/h if nothing was done to the design of the road. They might still have believed that we could keep 100 and accept the deaths. This opportunity was no longer possible with VZ. But still today, speed limits are set in a political and economic context, and this is no doubt wrong. They should be set entirely on a technical ground.

The economic models not only get the roles of mobility and safety wrong by putting them on a platform where they are exchangeable. They also seemed to fail in predicting the price to save lives. New methods, innovation, and cost reduction normal for the industrial sector have all contributed to gradually lowering the price of life. In particular, benefit-cost ratio models to choose alternatives do not seem to

drive innovation. These models do not seem to account for things like competition and consumer demand and not even innovation. They do not even seem to be able to handle what we would call system effects, one example being improved pedestrian protection by vehicle design. What is evident from both experimental models and empirical results is that the effectiveness of improved design is far larger if the speeds are low. So if urban areas reduce speed and speed limits, the investment in car design is higher. These kinds of effects are probably more common and larger than we have earlier claimed, as we have treated safety as a matter of individual countermeasures rather than system design.

What we might discuss as a way to be more "technical" would be the introduction of "predefined acceptable risk" meaning that we decide what safety level we accept at any location and any design solution. In aviation, railway, and many other parts of the society, this is a natural way to handle safety and impact on health. Railway regulation in the EU is strict about the acceptable risk and in essence has decided on a level for each country of one per one million lifetime risk for a fatality. Applied to road traffic, we would have around 5 deaths/year in the EU instead of 25,000. The beauty with this approach is that each provider would have to calculate in advance what a certain design solution would perform. In any case, some kind of movement towards a more regulated role for the providers would probably be helpful. The current situation, more or less unregulated, seems to allow the use of inferior solutions without any restriction.

The issue about acceptable risk will become evident when we get closer to automated vehicles. No doubt, a "machine" or robot designed by humans must be safe, at a level where railway and aviation is. And it is a fair assumption that any risks taken by an automated vehicle are not acceptable, i.e., we are getting close to the one per one million lifetime risk level. I am not sure that everyone understands that even if an automated vehicle is far safer than the vehicle driven by a human, it is never going to be enough. On average, an automated vehicle needs to be on a level that is 1000 times better than the conventional car. Anything else would be seen as unethical.

The introduction of the 2030 Agenda, or the Sustainable Development Goals, is a major step forward for safety. But it is not restricted to the first global goals for traffic safety, it is even more important to be able to use all the instruments and arenas associated with the 2030 Agenda. The institutions and large corporations, the economic logics of investment funds and actors, and the combination between safety, health, and climate will change the world quicker also for safety. When the large corporations in their value and supply chains will be asked how many children they kill by using the road transport system, this will no doubt start processes we have never seen before. Or when taxi and transport services must declare how they secure their vehicles and the way they are driven, something extraordinary will take place. Investors wish to keep their assets safe and will be talking to the large players how they will go about to reduce their societal harm.

When cities discover that they by procurement can control the urban mobility and its qualities; reduce particles, CO_2, etc.; and increase the attractiveness by geofencing of speed, this is a really big change. The nine recommendations from

the expert group for the third ministerial conference on road safety pick a lot of opportunities when combining the instruments of the 2030 Agenda. And it picks up a sort of Vision Zero for many qualities of the world, by saying that we cannot just concentrate on one target at the time.

The question about how we formalize VZ is and has been common. Is it necessary that nations, local governments, road administrators, and others are bound to VZ by regulations and even laws? This question has been exposed in two governmental investigations, both times with Matts-Åke Belin as an insightful secretary. And both times, it was proposed that such regulations should be brought in place. It would give the Parliament a more secure situation as to what public bodies would be expected to do. But very little of the proposals in the investigations were brought to the Parliament for decision.

Reflections

Should we be angry and upset over the 100 million deaths over the past 100 years? Is there anyone out there who is guilty of all deaths or at least many of them? Or did anyone make a fortune through all deaths or stop progress? There are more questions that we should try to answer when we look back at an almost unbeatable man-made catastrophe. The answer to the above questions is probably no, and there has certainly not been a conspiracy. We could have done things better, earlier, or more widespread. And we could certainly have done things in parts of the world where too little has been done. But many professionals, researchers, engineers, and organizations have done great things that gradually have made road transport safer and given us very much knowledge.

At the same time, our field has been full of good hope, amateurism, and poor science. Even today, the populism around speed is widespread, and proponents of a better speed management are often treated negatively, as if their facts are just an opinion and should be compared to the opposing opinion that speed does not really matter. In a way speed becomes a political issue.

And there are things that still might be hurdles to progress. I find very little excuse in the lack of funding. Safety is cheap, simple, and possible anywhere. And there is no excuse at all for building another undivided road, an intersection that is not a roundabout or a street without pedestrian crossing that create safe speed; or to build another car without seat belt reminder or pedestrian-friendly design; or to develop a supply chain with trucks and lorries without controlling their speeds; or run a bus line without geofencing. None of these examples cost any substantial amount of money, but improve safety greatly. I am not sure what stops us to do things better, if there are no costs, no drawbacks, and no side effects. Probably there are still norms, beliefs, and amateurism or even populism stopping. In any case, there is scope for large reductions, anywhere in the world.

The real hope is the 2030 Agenda and that safety becomes quality of life (Beyond 2020). That safety is something we like because it creates freedom – not only freedom of injury but also freedom to move and freedom for our children to walk

to school, activities, and friends. When freedom to move mean education, social interaction and better health trough exercise.

What has been bothering me since the very beginning of VZ is if we need legislation to force providers of road infrastructure, vehicles, and transport services to start acting as responsible cultures. Do we need laws to put the human life and health in the middle? We started with an insight that the providers have the major role for safety and thought a few ethical guidelines would be enough. It was probably a good first step, but it seems not to be enough. And policies and targets set by the Parliaments have also been helpful, but not enough.

Maybe we should express traffic safety as a "human right" like we did with the Tylösand Declaration. In this declaration, individual citizens should expect providers to do their outmost to protect their lives and to adopt the principles of continual improvement. The Tylösand Declaration was the forerunner to ISO 39001, the safety management standard for traffic safety. But it is still not a legal rule to adopt and use ISO 39001. All sorts of providers can still at large use their own standards and internal rules. So maybe we are about to ask ourselves the question if we need to bring traffic safety into the human rights corner and make it legally binding to act with the human life and health at the center – a "duty of care" rule for all providers. Maybe we need to legally protect every human against being the victim of amateurism, trade-offs, and blame!

Cross-References

► Saving Lives Beyond 2020: The Next Steps

References

Belin, M.-Å. (2012). *Public road safety policy change and its implementation – Vision Zero a road safety policy innovation* (Thesis). Karolinska Institute.

Eberhard, D. I. (2006). Trygghetsnarkomanernas land (In the country of security addicts). Sverige och det national paniksyndromet (Sweden and its national panic syndrome) Norstedts.

Elvik, R. (1999). Can injury prevention go too far? Some reflections on some possible implications of Vision Zero for road accident fatalities. *Accident; Analysis and Prevention, 3*(3), 265–286.

Haddon, W. (1970). On the escape of tigers. An ecological note. *American Journal of Public Health, 60*(12), 2229–2234.

Lindberg, H., & Håkansson, M. (2017). Vision Zero. How dreams can become reality. ÅF Stockholm.

Safety Net 2019. http://ec.europe.eu Cost-benefit analysis.

Beyond 2020, The next steps – Recommendations of the Academic Expert Group for the Third Ministerial Conference on Global Road Safety 2020.

Tingvall, C., & Lie, A. (1996). *The implications of the Zero Vision on biomechanical research. Bertil Aldman lecture at IRCOBI 1996*. In Proc IRCOBI Conf.

Tingvall, C., & Lie, A. (2017). Traffic safety from Haddon to Vision Zero and beyond. In *Blue book of automobile safety* (pp. 316–333). Beijing: Social Science Academic Press.

Tingvall, C., Johansson, R., & Lie, A. (1996). Traffic safety in planning, a multidimensional model. In *Traffic safety, communication and health. Transportation, safety and health* (pp. 61–69). Brussels.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.