# Part II

# Vision Zero: An International Movement for Traffic Safety

# Vision Zero: How It All Started

# 7

Claes Tingvall

## Contents



**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





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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 pre-requisites 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!

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► Saving Lives Beyond 2020: The Next Steps

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# Vision Zero in Sweden: Streaming Through Problems, Politics, and Policies

# 8

Matts-Åke Belin

## Contents



**Abstract**

In 1997, the Riksdag, the Swedish Parliament, adopted Vision Zero as a new goal and strategy for road safety in Sweden (Swedish Government 1997). In the more than 20 years since the Vision Zero policy was adopted, it has spread internationally as a model of a public road safety policy (OECD/ITF 2008, 2016; World Health Organization 2017). It is not only in the transport sector that Vision Zero has attracted interest; it has also spread and continues to spread to other sectors of

M.-Å. Belin (✉)
Department of social determinants of health WHO, Geneva, Switzerland
e-mail: matts-ake.belin@trafikverket.se



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Swedish society such as fire safety, patient safety, occupational accidents, and suicide (Kristianssen et al. 2018). Although, road safety policies and strategies can be developed and adopted by a variety of actors at different levels in the society in a democracy, parliaments have a special position, and it establishes an exclusive legitimacy in the society. According to the Swedish Constitution (Swedish Parliament 2016), all public power proceeds from the people, and the Riksdag (the Swedish Parliament) is the foremost representative of the people. Therefore, this chapter focuses on the Swedish Parliament and the Swedish Government and how road safety, as a public policy, finds its way into public agenda in a competing political environment. The decision to adopt Vision Zero in Sweden was a rather radical change (Belin et al. 2011) of that time safety policy. This chapter examines the political decision-making process that preceded the decision by the Swedish Parliament to adopt the Vision Zero policy in 1997 (Swedish Parliament 1997) and the decision to re-evaluate Vision Zero in 2004 (Swedish Parliament 2004).

**Keywords**

Road safety · Public policy · Implementation · Public policy process · Sweden · Garbage can

## Introduction

In 1997, the Riksdag, the Swedish Parliament, adopted Vision Zero as a new goal and strategy for road safety in Sweden (Swedish Government 1997). In the more than 20 years since the Vision Zero policy was adopted, it has spread internationally as a model of a public road safety policy (OECD/ITF 2008, 2016; World Health Organization 2017). It is not only in the transport sector that Vision Zero has attracted interest; it has also spread and continues to spread to other sectors of Swedish society such as fire safety, patient safety, occupational accidents, and suicide (Kristianssen et al. 2018). Although, road safety policies and strategies can be developed and adopted by a variety of actors at different levels in the society in a democracy, parliaments have a special position, and it establishes an exclusive legitimacy in the society. According to the Swedish Constitution (Swedish Parliament 2016), all public power proceeds from the people, and the Riksdag (the Swedish Parliament) is the foremost representative of the people. Therefore, this chapter focuses on the Swedish Parliament and the Swedish Government and how road safety, as a public policy, finds its way into public agenda in a competing political environment. The decision to adopt Vision Zero in Sweden was a rather radical change (Belin et al. 2011) of that time safety policy. This chapter examines the political decision-making process that preceded the decision by the Swedish Parliament to adopt the Vision Zero policy in 1997 (Swedish Parliament 1997) and the decision to re-evaluate Vision Zero in 2004 (Swedish Parliament 2004).

## Theoretical Considerations on Agenda Setting

Public health experts in general and road safety experts specifically by nature look favorably on a rational comprehensive approach to public policies and public policy processes (Sleet et al. 2003; Elvik et al. 2009; Bugeja et al. 2011), at least from a normative perspective. Therefore, based on this rational view, experts have a tendency to mistrust public policy process and see them more or less as irrational. On the other hand, practitioners often highlight policy processes as incremental to its nature. In contrast to the comprehensive approach, scholars such as Lindblom (1959, 1979) praise incrementalism both a good description of reality and something to strive for. In 1984, the first edition of Professor John W. Kingdon's famous book *Agendas, Alternatives, and Public Policies* (Kingdon 1995) was published. Its theoretical starting point challenged both the rational and the incremental approach to public policies. In this book, a policy stream model is described, which could be applied to analyze and explain public agenda setting in our society. According to Kingdon (1995, 2003), a public policy process in the society is rather chaotic in its nature, and the work of the governments could appear as organized anarchy, and by this statement he joined what was referred to as the "garbage can" perspective on public policies (Cohen et al. 1972). Kingdon (1995, 2003) emphasized *organized* because public policy processes are not only total chaos; on the contrary, it still has structure and patterns. Separate streams run, and each has a life of its own. Three major streams –problems, policies, and politics – are coupled at critical junctures and produce changes in agenda. First, according to the model, various problems capture the attention of people in and around the Government, and there are various different reasons how and why one set of problems rather than another comes to the attention of public officials. Secondly, there is a policy community with a wide range of people who each have their own ideas that they want to promote. Thirdly, the political stream is composed of factors like swings of national moods, public opinion, elections results, and changes of administration, which might result in shifts in partisan or ideological distribution. People, such as politicians, bureaucrats, experts, and those involved in interest groups or media businesses, among others, are all involved in the different processes and could both push for changes or work against changes. However, the policy entrepreneurs, advocates who are willing to invest time and efforts, play a crucial role both within different streams and also in moments of coupling. According to the model, the three different streams develop and operate largely independent of one another; however, sometimes these streams come tighter at critical times, and a window of opportunity opens. A problem is recognized, a solution is on the table, and the political climate makes the time right for change, and the constraints do not prevent things to happen. Based on the stream model, in this chapter, the problem-, politics-, and policy-stream and how they are joint together in two different Vision Zero cases (Fig. 1).


**Fig. 1** Summary of actors and processes in a public policy process

## Multiple Streams Leading to the Adoption of Vision Zero, Adopted by the Swedish Parliament in 1997

Sweden has a long-standing tradition of managing the public road safety with the support of overall goals rather than detailed instructions to public authorities and via governmental regulations (Belin et al. 2010, 2014). Already in 1982 the Swedish Parliament decided to adopt goals for road safety (Swedish Parliament 1982). These goals were in effect for 15 years, until they were replaced by Vision Zero (Swedish Parliament 1997); see Table 1.

The goals adopted in 1982 were largely based on a socioeconomic framework. The total number of people killed and injured indicates that an increased number of fatalities could, in theory, be compensated by a reduction of injured. In other words, these goals could lead to an emphasis on interventions that aim to reduce less complicated injuries rather than to interventions which could save a fewer lives. The last two goals were focused on vulnerable road users and were aiming at fair and equal safety among all different road users.

## The Logic and Approach of Vision Zero

In order to identify, analyze, and explore different public road safety policies between countries, cities, sectors, and changes over time, one might need a method which uses a model for a schematic view over reality and where the real world complexity is reduced and made more comprehensible. In social science these models, the ideal type (or pure type) is closely associated with sociologist Max Weber (https://en.wikipedia.org/wiki/Ideal_type) and has been used in many different settings (e.g., Vedung 2021) but also to analyze Vision Zero (Belin 2011; Kristianssen 2018). Vision Zero differs from a traditional road safety policy in a number of ways. A more traditional approach to people killed and seriously injured as a consequence of road traffic accidents has been the utilitarian philosophical approach (Bowen 2012; Belin 2012). Utilitarianism, as it has come to be applied

**Table 1** Road safety goals. (Adopted by the Swedish Parliament 1982, 1997)

| | 1982 | 1997 |
|---|---|---|
| Overall goals | The total number of people killed and injured in traffic should steadily decline | No-one shall be killed or seriously injured as a consequence of accidents in road traffic. The design and function of the road transport system shall be adapted to meet the requirements that follow from Vision Zero |
| | The risk of being killed or injured in traffic should be steadily reduced for all categories of road users | |
| | The risk of being killed or injured in traffic should be reduced to a greater extent for vulnerable road users than for protected road users | |
| | Particular attention should be paid to the problems faced by children | |

within the road traffic sector, means that safety has to be weighed against other types of benefits. In theory, and to a large extent in practice, this approach means that those killed and seriously injured are a price that society simply has to pay for the mobility of the road transport system and that there are an acceptable number of deaths and serious injuries. Safety is to be gradually improved, but only to the extent that is socioeconomically advantageous. In addition, to a large extent the traditional road safety work is based on the fact that people are willing to take risks and that it is simply part of human nature. The long-term objective of Vision Zero is to establish a road transport system in which nobody is killed or seriously injured as the result of a traffic accident. Thus, Vision Zero aims in the long term to create a safe road transport system.

The justification for this absolute and uncompromising attitude is what moral philosophy would attribute to deontological ethics (Bowen 2012; Belin 2012), i.e., it should not be inevitable that anyone would be killed or seriously injured when moving via the transport system from Point A to Point B. Road transportation can be regarded as a type of transport production. The same as a society cannot accept people killing or seriously injuring themselves as a consequence of producing goods and services within industry, Vision Zero finds it unacceptable when transportation is produced. According to Vision Zero, mobility is therefore subordinate to safety, at least over the long term. If it is impossible to create a safe system, it should inexorably have consequences for mobility. Furthermore, Vision Zero is based on the fact that people do not want to die or be seriously injured as the result of a road traffic accident, and therefore each person has his or her own Vision Zero. Vision Zero and the traditional safety policy thus differ from each other when it comes to what is the long-term objective of the safety work and its normative ethical fundamentals.

Knowledge based on investigations of actual traffic accidents that answer questions about why accidents happen points sharply in the direction of the fact that it is the individual transport user who is the missing link in the road transport system. To a significant extent, the traditional road safety activities are based on behavioral science research which draws the conclusion that 90% of all road traffic accidents can be explained by a human factor (Evans 2004). In the traditional safety work, the principal challenge is to prevent conscious and subconscious faulty human action. As a basic starting point, Vision Zero instead accepts that human beings make conscious and subconscious mistakes, which is why accidents occur, and that the safety work primarily must be directed at those factors which can prevent accidents leading to death or serious injury. Accidents in and of themselves can be accepted, but not their serious consequences.

According to Vision Zero, the principal cause as to why people die or are seriously injured is that the kinetic energy to which people are exposed in a traffic accident is excessive in relation to the energy that the human body can withstand. Vision Zero is based on among other things the research that the well-known American road safety expert William Haddon conducted in the 1960s (Haddon 1968, 1980). Knowledge about energy forces and tolerance has largely served as a basis for the development of the passive safety characteristics of vehicles and for the development of different protection systems such as child safety seats, helmets, seat belts, etc. One important consequence of the adoption of Vision Zero as a public policy is that scientific knowledge about kinetic energy, which has served as a very important basis for the development of a sub-component in the road transport system, namely, the vehicle, also has become a general principle for the entire road transport system and its components.

In the traditional safety work, ultimate responsibility for safety rests with the individual. According to the traditional view, it is the individual road user who ultimately controls and manages the risks that may occur when travelling on the road transport system. The regulations surrounding the road transport system are clear and unambiguous on this point. If a road traffic accident occurs, it is possible in most cases to hold a certain identifiable road user liable for the deficient observance of regulations. Even if, for example, a road authority has made a mistake in the design of a road, it is the responsibility of the road user, via the general requirements for caution that are built into the traffic legislation, to provide compensation via his/her behavior for such road deficits. According to Vision Zero, it is not the individual road user who has the ultimate responsibility, but rather that falls upon the system designers. The responsibility for safety is thus split between the road users and the system designers (i.e., infrastructure builders and administrators, the vehicle industry, the haulage sector, taxi companies, and all the organizations that use the road transport system professionally), on the basis of the principles that:

- The system designers have ultimate responsibility for the design, upkeep, and use of the road transport system and thus are responsible for the level of safety for the entire system
- As before, the road users are still responsible for showing consideration, judgment, and responsibility in traffic and for complying with the traffic regulations

- If the road users do not adequately assume their share of the responsibility, for example, due to a lack of knowledge or skill, or if personal injuries occur or risk occurring for other reasons, the system designers must take additional further measures to prevent people being killed or seriously injured

In Vision Zero, the responsibility for safety is a chain of responsibility that both begins and ends with the system designers.

To a large extent, traditional safety work is based on the notion that individuals and the society largely speaking do not ask for safety. There are other values that that are given a higher priority, such as accessibility. Traditional traffic safety strategies are thus based to a large extent on the “unwilling road user” who must be forced into giving consideration to safety. Vision Zero is instead based on individuals and society demanding and requiring safety. The basic starting point of this policy is that everyone has their own “personal vision zero.” The fact that people sometimes act as though they do not need or require safety has, according to Vision Zero, rather more to do with inability, ignorance, and a lack of social support than a lack of will or need.

## Problem Stream

In order to understand the context in which Vision Zero was originally developed from, we need to look back historically on the road traffic injury trends in Sweden. After World War II, Sweden experienced tremendous economic growth, along with fast motorization and urbanization. The popularity of the automobile took off, and the road transport system was developing rapidly. Unfortunately, there was also a negative side to this development: the greater the volume of motor traffic, the more people were killed and seriously injured in traffic accidents. In 1964, Sweden had 17 fatalities per 100,000 inhabitants annually on the roads. This is similar to the average number for what the whole world is facing nowadays: 18.3 fatalities per 100,000 inhabitants (according to the World Health Organization’s estimations (WHO 2018)).

The situation during the 1950s and 1960s was unacceptable, and it correlated poorly with the modern welfare state that was beginning to take form and especially among the medical professionals; there was a growing frustration and a growing demand for measures to be taken. Parallel with this growing awareness of the need to do more to reduce road traffic injuries, the Swedish Government prepared a rather unique reform, namely, the transfer of the road traffic from left-hand traffic (LHT) to right-hand traffic (RHT) (1954 Års Kommitté för Utredning om Högertrafik 1954).

The rationale for this reform was that Sweden’s Scandinavian neighbors were driving on the right side of the road as was most of Europe. Furthermore, most Swedish cars also had left-hand steering. However, there was a strong public opinion against this reform, and the public argued that a change from left-hand traffic to right-hand traffic could increase the number of road traffic injuries even more (1954

Års Kommitté för Utredning om Högertrafik 1954). However, the Swedish Government decided to adopt the reform (Swedish Parliament 1963), but in order to react on these public fears and to make sure that the reform could be carried out without increasing the number of road traffic injuries, the Government set up a special organization, "Högertrafik Kommissionen" (Commission to Study Right Hand Traffic) (Swedish Government 1963). This commission consisted of several experts within different areas of expertise such as road, human factor, and vehicle design. The commission planned and implemented massive informational campaigns before and during the change in 1967, and the reform was a great success. Figure 2 shows that the change was successful from a road safety perspective. Instead of increasing the road traffic deaths, which had been the worst fear among critics of the reform, the number of deaths in road traffic decreased the next year; however, in the years that followed, the number went up again.

However, during the middle of the 1960s, a seed had been sown for a comprehensive and systematic road safety work through Ralph Nader's book *Unsafe at Any Speed* (Nader 1965). In the United States, this book contributed to spur the passage of the National Traffic and Motor Vehicle Safety Act in 1966 and the creation of several predecessor agencies which would eventually become the NHTSA, the US National Highway Traffic Safety Administration (Graham 1989). This book played a similar role for the road safety movement as what Rachel Carson's book *Silent Spring* played for the environmental movement (Carson 1962).

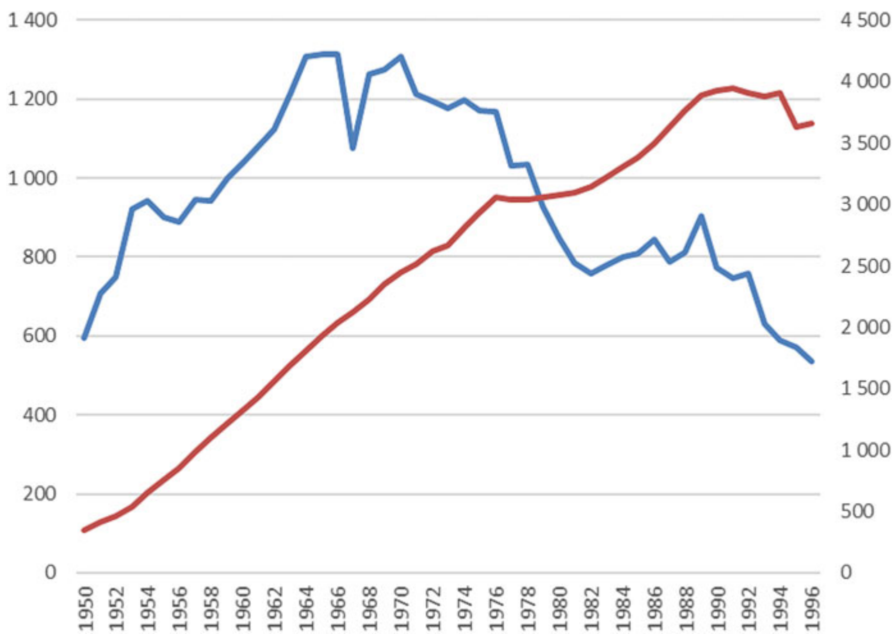


**Fig. 2** The number of killed persons in road traffic accidents and the number of passenger cars per thousand inhabitants 1950–1996 in Sweden

Around the same time, a former Swedish Prime Minister, Olof Palme (https://en.wikipedia.org/wiki/Olof_Palme), who at the time was Minister of Communication, was deeply influenced by Ralph Nader and his book. He even arranged for the book to be translated into Swedish, and he also took the initiative, based on an American model, to set up a special authority for road safety issues, Statens Trafiksäkerhetsverk – the Swedish Road Safety Agency.

The establishment of the Road Safety Agency can be said to be the starting point for systematic road safety activities in Sweden. This work was successful during the 1970s, and the number of traffic fatalities people killed on the roads dropped from 17 fatalities killed per 100,000 inhabitants in 1964 to 9.1 killed per 100,000 inhabitants in 1982 – a decrease of over 40% (Transport Analysis 2020).

During the 1980s, the positive trend was broken, and traffic growth and road injury figures began to follow each other: the more car traffic, the more people were killed on the roads. In 1989, Sweden had 10.6 fatalities per 100,000 inhabitants, and Sweden was, once again, approaching four-figure numbers of road deaths. A sense of a loss of control was spreading in the society and together with political pressure to do something more radical – and this eventually (in 1993) led to the dismantling of the Swedish Road Safety Agency and to an enhanced role for Vägverket, the Swedish Road Administration (Swedish Parliament 1992).

Parallel with this process to change the institutional prerequisites for the national road safety work, Sweden was facing a severe economic recession in the first half of the 1990s. During the period 1990–1993, Swedish GDP fell by almost 5%, and the level of unemployment increased dramatically (Hassler 2010). From a road safety perspective, at least in the short run, we know that economic recessions might have a positive impact on safety, and this was also the case in the beginning of the 1990s (OECD/ITF 2015). The number of fatalities fell between 1989 and 1996 by more than 40%.

The trend in the beginning of the 1990s was therefore different from what Sweden had experienced in the late 1960s. The situation went from the negative alarming situation, which demanded a remedial response, to a more optimistic promising situation which signaled possibilities and future confidence.

## Political Stream

Historically, the Swedish Social Democrat Party has a unique position in the five-party configuration party system of Sweden which emerged at the end of World War I. They were in power, by themselves or in coalition with other parties, from 1932 to 1976 (Vedung 1988; Östberg 2012). A systematic road safety work after World War II is therefore highly associated with the Social Democrats' political ambition to create a modern welfare state. Political road safety initiatives taken in the late 1960s and during 1970s were important from a road safety perspective and contributed to decoupling the trends with more traffic and road deaths. In 1976, the Social Democrats lost the Government office, and they were in opposition until 1982 when they came back into power. Several of the most obvious road safety interventions in that time were already in place, such as legislation concerning drink and driving, the wearing of helmets and seat belts, speed limits, the driving license system, periodical inspection of motor vehicles, upgraded road infrastructure in both rural and urban areas, etc. Therefore most of the political discussions during the 1980s were about organization and working methods and efficient delivery methods, rather than new interventions (Swedish Standing Committee on Transport and Communications 1984; Trafiksäkerhetsutredningen 1991).

From a road safety perspective, the 1980s became the lost decade, and the Social Democrats started to distrust their lead agency on road safety. Further, although we cannot know for sure, Olof Palme, the main architect who was assassinated on a street in Stockholm 1986, was not around to defend his creation. In 1990, the Social Democratic Government appointed a commission of inquiry with the main task to change the government organization, and its directive pointed out rather clear that there was no need for a special road safety agency (Trafiksäkerhetsutredningen 1991). In 1991 the Social Democrats lost their power again to a moderate, center-right Government, and it was a transport minister from the Christian Democratic Party who carried the commission proposal further, and the Government decided to, from the end of 1992, close down the former Swedish Road Safety Agency and move all its tasks and responsibilities to the former Swedish Road Administration (Swedish Parliament 1992).

The underlying political argument to close down the former Swedish Road Safety Agency was to increase the effectiveness in the road safety work via a reduction of the number of stakeholders within the sector and extend the road authorities responsible, not only to build and maintain roads but also to an overall responsibility for safety in the whole system including vehicles and the use of the system (Swedish Government 1992). Perhaps a backward way of doing things, but first the Government decided on the organizational changes and then came the political direction of the road safety policy looking forward to the twenty-first century (Swedish Government 1993). According to the direction, the focus should be placed on the road users, and good road safety was ultimately a matter of individual road users' moral and attitudes. A fundamental concept that underpins this political direction was the thinking that both individual road users and the various decision-makers do not value safety sufficiently enough. In other words, a poor safety culture within the society is a major contributing cause to lack of improvements.

In October 1994, the Social Democrats came back into power. Mr. Ingvar Carlsson (https://en.wikipedia.org/wiki/Ingvar_Carlsson), now became Prime Minister, formed a Government of which for the first time half of the members were women (Swedish Parliament 1994). Ms. Ines Uusmann became Minister of Communication (https://en.wikipedia.org/wiki/Ines_Uusmann), and during a public speech in January 1995, she revealed three issues that she would prioritize during her term as Minister of Communication, namely, better environment, more use of information technology, and road safety (Lindberg 2002).

In 1996, the Government was reorganized, and Mr. Göran Persson (https://en.wikipedia.org/wiki/G%C3%B6ran_Persson) became the Prime Minister; however, he kept Ms. Ines Uusmann in the Cabinet as Minister of Communication and Transport.

## Policy Stream

When the Swedish Road Safety Agency was dismantled, the Swedish Road Administration became the lead agency for road safety. The Swedish Road Administration was a complex multi-goal agency, and to ensure that road safety gained a strong position within the organization, the Government instructed the Swedish Road Administration to have a person employed as a Road Safety Director. With other word, a policy decision aimed at ensuring that road safety interests were represented at the highest management level. Professor Kåre Rumar was appointed as the first Director of Road Safety. Mr. Rumar (http://web.hku.hk/~hhecwsc/KaraRumar.htm) was a professor of psychology and had extensive experience in the field of road safety plus was a world-leading academic in the field of human behavior and road safety. One of his first tasks was to develop, together with his colleagues at the Swedish Road Administration, a new road safety strategy. Although this strategy acknowledges the need for safe roads and safe vehicles, its primary policy priority was human attitudes and behavior (Swedish Road Administration et al. 1994). According to this strategy and the followed road safety program, the greatest potential for road safety improvements was to change peoples' attitudes to risk and lower their level of acceptance to risks. This strong focus on human factors was to a large extent based on research about behavior adaptation (Rumar 1988; Wilde 1994; Evans 2004). In the late 1980s and in the beginning of the 1990s, probably due to the negative road safety trend experienced in many western countries, the road safety community started to question some of the general road safety strategies (OECD 1990). These strategies, which were primarily focused on increasing people's capability (e.g., road users' skills) to handle risk and via different technical solutions (e.g., vehicle and road improvements which were aimed at lowering the demands made on the individual), make it easier for people to handle a complex road environment. According to this research, the road safety effects of these interventions could be everything from less effective to even increase the risks because of people's value of risk. Some researchers (Wilde 1994; Adams 1995) even launched the idea that all road safety interventions are useless and ineffective due to risk homeostasis. In the early 1990s, the road safety strategies were very much based on this behavior adaption concept, and if we could change people's appreciation and social norms for a focus on increased safety, even those interventions already implemented would deliver more safety. A strong focus was made therefore on individuals' attitudes and social norms which also was, as already mentioned, supported politically.

In the autumn of 1994, Adjunct Professor Claes Tingvall (https://sv.wikipedia.org/wiki/Claes_Tingvall) was employed as a new director of road safety at the Swedish Road Administration. Before Mr. Tingvall took up his new position, he worked as a research leader at Folksam, a Swedish insurance company. Mr. Tingvall represents a long tradition of researchers with the focus on injuries, biomechanical and protection devices such as seat belts, child restraint system (Tingvall 1987), and overall vehicle safety performance which started with Professor Bertil Aldman (https://sv.wikipedia.org/wiki/Bertil_Aldman) (Kolbenstvedt et al. 2007), a famous

Swedish researcher who made groundbreaking research in the field. Fairly soon after he started his new job, Mr. Tingvall and his colleagues at the Swedish Road Administration developed a new strategy which was named “The Vision Zero: A Road Transport System Free from Serious Health Losses” (Swedish Road Administration 1996). Very much based on his experiences within biomechanics, there was an opportunity to adopt this for an entire system. This strategy was to a large extent a 180 degree reversal from the previous strategy led by Mr. Rumar. Instead of focusing on individual attitudes, the strategy changed instead to create a safe system (vehicles and roads, in both urban and rural areas) for all road users. Control of harmful energy becomes a core aspect in this strategy. People’s attitudes vis-à-vis safety were not seen as a major problem. Rather, it was the opposite; everyone has their own Vision Zero for themselves and their loved ones, and Vision Zero was only a way to make that more explicit. Attitudes needed to change in the society and especially so among system designers rather than among individuals. It is not an overstatement to argue that Mr. Tingvall and his team suggested a paradigm shift in the way road safety as a problem in our society was framed and what appropriate strategies needed to be implemented along with what we should aim for – namely, to create a safe system without any fatalities or serious injuries. The former General Director, Per Anders Örtendahl https://sv.wikipedia.org/wiki/Per_Anders_%C3%96rtendahl), of the Swedish Road Administration was however skeptical. He was not in favor of this new idea, and the prospect that it would survive as a public policy under his leadership was rather non-existent. However due to a conflict with the new minister, Ms. Uusmann, Mr. Örtendahl resigned in early 1995. Mr. Örtendahl was a very colorful and strong leader, and when he resigned, the Swedish Road Administration was left in a state of vacuum, and the space to suggest new ideas increased substantially. Mr. Jan Brandborn replaced Örtendahl, and he initiated a major change of the organization, which commenced on 1 January 1996. General Director Jan Brandborn (https://sv.wikipedia.org/wiki/Jan_Brandborn) commissioned Mr. Tingvall to become responsible for a strategic road safety unit with approximately ten employees.

## Policy Window Opens Up

During the spring of 1995, a delegate from the Ministry of Communication led by the new minister visited the Swedish Road Administration, and they were briefed about the administration and its various important areas of work. Professor Tingvall got the chance to promote his view on road safety, and he shared the idea about Vision Zero for the first time with a political level. Ms. Uusmann found this idea politically attractive, and soon thereafter the political part of the policy process was initiated. In August 1995, Ms. Uusmann launched Vision Zero for the first time to the public via a debate article (Uusmann 1995). During the autumn, an intergovernmental task force was established with civil servants from the Ministry of Communication, Ministry of Justice, and other ministries together with three experts from the Swedish Road Administration: Tingvall, Lars Eriksson (former Stenborg), and the author of this chapter (Swedish Ministry of Communications 1996a). The task force's mission was to describe and explore Vision Zero and to formulate concrete recommendations based on Vision Zero approach. A list of 28 topics was identified within the task force relating to different policies. Some of these had been discussed previously, and some were new and due to Vision Zero. Most of the recommendations were investigated and prepared by the Swedish Road Administration and discussed in the Group for National Coordination (GNS group) . In 1993, the Swedish Road Administration had established a group for national coordination of road safety with participation from different stakeholders in the Swedish society which worked on and had a stake in road safety. This group played an important role to both identifying important interventions and anchoring various different recommendations before a political process. They also supported the organization of two open road safety seminars (Swedish Ministry of Communications 1996b) during the spring of 1996. These seminars played an important role for Ms. Uusmann to try Vision Zero publicly as a concept and some of the interventions which would follow of a policy such as Vision Zero. The feedback both from the general public and the news media coverage strengthened Ms. Uusmann and her desire to transform Vision Zero from an expert idea to public policy. Both Vision Zero and some of the policy recommendations were incorporated into a public document by civil servants at the Ministry of Communication. However, in order to obtain full support from the other ministries, the concrete recommendations were somewhat watered down. The public document was thereafter referred for comment to over 100 organizations in the Swedish society. The support for Vision Zero in general was overwhelming, except a few critical comments focusing primarily on costs, effectiveness, and realism. Based on this support, a draft proposal to the Parliament was developed. Due to the fact that most of the concrete recommendations were pushed into the future, the proposal was more of an overall long-term strategy, without concrete measures taken (Swedish Government 1997).

On 9 October 1997, the Swedish Parliament decided to adopt a new direction and a new long-term goal for safety in road traffic – Vision Zero.

> The Parliament supported the Government's decision to adopt a new direction for traffic safety based on the Vision Zero framework. The goal is that nobody will be killed or seriously injured as a consequence of accidents in road traffic. The design and function of the road transport system is to be adapted to meet the requirements that follow from Vision Zero. (Swedish Parliament 1997)

Five months earlier on 22 May 1997, the Social Democratic Government had submitted a Bill entitled "Vision Zero and a traffic-safe society" to the Swedish Parliament for processing. The Parliamentary Committee proceeding concerning the Government Bill did not lead to any changes, and all the parliamentary parties voted in support of it. On the other hand, the Green Party objected, in a reservation, to the decision to replace the traffic safety goal that was in effect at that time. The Green Party felt that Vision Zero should include specific sub-goals which, among other things, would focus on the problems faced by children in traffic. This reservation meant that the Parliament was forced to adopt a stance on two issues. Basically, all

**Table 2** Vision zero as a long-term goal. Vote in the Swedish Parliament on the Committee's proposal against the Green Party reservation on 9 October 1997

| Party | Yes | No | Refrain | Absent |
|---|---|---|---|---|
| The Social Democratic Party | 137 | 0 | 0 | 24 |
| The Moderate Party, Liberal Conservatism | 66 | 0 | 0 | 14 |
| The Centre Party, Centrism, Agrarianism, Social Liberalism | 21 | 0 | 0 | 4 |
| The Liberal People's Party, Social Liberalism | 19 | 0 | 0 | 14 |
| The Christian Democrats, Christian Democracy | 9 | 0 | 0 | 6 |
| The Left Party, Socialism, Feminism | 19 | 0 | 0 | 3 |
| The Green Party | | 15 | 0 | 3 |
| Total | 271 | 15 | | 68 |

parties were in favor of Vision Zero; however, the Green Party wanted a general goal with sub-goals to be specified (Swedish Standing Committee on Transport and Communications 1997). Table 1 shows the outcome of the Parliamentary voting (Swedish Parliament 1997). The Parliament, with a substantial majority, adopted Vision Zero as a new long-term traffic safety goal, which entailed a new direction for the safety work involved (Table 2).

## Vision Zero: Continued Action for Road Safety, 1998–2004

In November 2004, 7 years after the Swedish Parliament adopted Vision Zero, it was time for a comprehensive discussion of the direction of public road safety work in Sweden and to reconsider Vision Zero as a long-term goal and strategy. Additionally to Vision Zero, the Swedish Parliament had also in 1998 adopted (Swedish Parliament 1998) an intermediate target for 2007 to halve the number of fatalities. Thus, this was a moment for the Swedish Parliament to reflect and to reconsider Vision Zero and the intermediate target for 2007. The decision could be summarized in one sentence: Vision Zero lies steady, and although it will be a great challenge, the intermediate target is fixed. In contrast to the decision in 1997, this proposal was also discussing, to a greater extent, concrete road safety measures (Swedish Government 2004; Swedish Standing Committee on Transport and Communications 2004; Swedish Parliament 2004).

According to the Government proposal, the work with Vision Zero should not be seen as a one-off effort but rather as an ongoing process. To be successful, road safety work must be integrated into the processes that affect the design and function of the road transport system. The Swedish Government made an assessment and stated that the work with Vision Zero had just begun and should now be deepened and intensified. Many of the measures taken since Vision Zero was adopted were long-term solutions. For example, extensive measures have been taken to improve safety in road environments and in vehicles. The new direction in road safety work entails, among other things, that the system designers take greater responsibility for safe road traffic. In-depth studies of fatal accidents and the OLA process (a planning model in order to include different stakeholders) are important instruments for coordinating the work of different system designers to improve road safety.

Although the Government felt that the long-term work was doing well, they were more worried about the results in the short term. According to the Government, in light of the past 10 years of the road safety work and the available knowledge, it will require great efforts by all stakeholders to achieve the goal in 2007. According to the Government, system designers always have the ultimate responsibility for the design, maintenance, and use of the road transport system. They together have an informal responsibility for the entire level of security of the system. The work to integrate safety in the road environment, in the quality assurance of transport, in the occupational health work, and in vehicle development must therefore continue and intensify. According to the Government, this would make a great contribution also to the short-term target.

However, this was, according to the Government, not enough. The road users also have a responsibility to follow traffic rules, and according to the Government, road users' compliance was going in the wrong direction especially when it comes to speeding and drink and driving. Therefore the Government suggested several new interventions with a focus on individual road users, such as automated speed enforcement, increased penalties, and the requirements for a driving license, among other things.

## Problem Stream

After the severe recession in the beginning of 1990, the Swedish economy started to recover in the second half of this decade. The unemployment rate decreased from about 11% in 1997 to 6% in 2001 (www.ekonomifakta.se/Fakta/Arbetsmarknad/Arbetsloshet/Arbetsloshet/). During the same period, after some years of stagnation, road traffic grew by about 10% (Transport Analysis 2019). Once again, the strong relationship between general economic developments, especially in the short run, and road safety was shown again. turned out again. Despite the bold policy of Vision Zero to eliminate fatalities and serious injuries, the short-term trend showed no sign of progress but rather the opposite.

According to Kingdon (2003), it is not only how the society traces common indicators that play a role for agenda setting and the policy system but also spectacular rare events that can trigger public decision-making. Based on this, one event in 1998 and two events in 1999 need to be mentioned. In November 1998, a large bus went off a slippery road and started to burn, but as a miracle, all passengers survived. In January 1999 in one traffic collision, six children and two adults lost their life. In February 1999 in one traffic collision, seven children and two adults lost their life. Together, 13 children were killed in these 2 road accidents.

## Political Stream

Ms. Uusmann retained her position as Minister for Communications until the autumn of 1998. After a new election and despite a large drop in voter support, the Social Democrats stayed in the Government with support from left and environment parties. Prime Minister Persson decided to reorganize the Government, and the

Ministry of Communication, Ministry of Industry, and Ministry of Employment were merged into one large Ministry of Enterprise. The idea was to create a strong ministry for economic growth. As a consequence, the most important political proponent of Vision Zero lost her political power. Mr. Björn Rosengren (https://en.wikipedia.org/wiki/Bj%C3%B6rn_Rosengren) became the first minister with overall responsibility for this new ministry. Mr. Rosengren was not a great enthusiast of Vision Zero. Mr. Rosengren saw Vision Zero as a utopian unrealistic goal which at best could serve as a benchmark to encourage the society to do its best (Hakelius and Rosengren 2016). Despite his doubt, it seems that Mr. Rosengren had no intention to start a process in order to replace Vision Zero, and he emphasized that the main focus was to achieve an intermediate target, less than 400 fatalities and 3,700 serious injuries in 2000. Soon after Mr. Rosengren took office, he was forced to deal with the events mentioned above. In April 1999, the Government together with the Swedish Road Administration launched an 11-point program (Swedish Ministry of Enterprise 1999) for road safety which turned out to be, when we look back, a very important document to go from Vision Zero as a policy to real action. Despite this effort, the number of fatalities did not drop, and Mr. Rosengren in August 2002 took another initiative to create a national coalition for road safety with focus on behavioral risk factors (Swedish Road Administration 2002).

In 2002, after the election, Mr. Persson managed to stay as prime minister for another term, and the Government was once again reorganized, and Ms. Ulrica Messing (https://sv.wikipedia.org/wiki/Ulrica_Messing) was appointed as new minister with responsibility for infrastructure in the Ministry of Industry, Employment, and Communications. In contrast to Mr. Rosengren, Messing was a clear advocate for Vision Zero and in this respect more in line with the previous minister Ms. Uusmann. Ms. Messing became responsible for the second comprehensive proposal on Vision Zero to the Parliament in 2004 when she asked the Parliament for continued action for safe roads (Swedish Government 2004).

Even though Mr. Persson reorganized the Government in 1998, the Swedish Parliament and its different committees were the same. The Standing Committee on Transport and Communications is responsible to process Government bills and to process other proposals from members of the Parliament on road safety. In the autumn of 1998, a process was commenced to manage the various different proposals from the members in the Parliament which were focused on road safety. This is a reoccurring process that arises about once a year. One important factor was that the chairperson at that time was Ms. Monica Öhman (https://sv.wikipedia.org/wiki/Monica_%C3%96hman). Ms. Öhman represented the Social Democratic Party and had been in that position from 1994 and thereby had been responsible for the parliamentary process to manage the Government's Vision Zero proposal and to follow its implementation over the years. Ms. Öhman was a strong advocate for road safety, and after her time as chairperson, she became Executive Director of an important road safety non-governmental organization in Sweden, the NTF, National Society for Road Safety. Ms. Öhman and the rest of the members in the Committee on Transport and Communications expressed great concern about the situation and sent a clear message to the Government. In a committee report (Swedish Standing

Committee on Transport and Communications 1999a), adopted by the Parliament in April 1999 (Swedish Parliament 1999), the committee unanimously stated that Vision Zero provides a firm ground, and this required a continuous reduction in the number of killed and injured in traffic, and this must not be abandoned. According to the committee, it was important that the Swedish Government paid special attention to Vision Zero, and they also wanted the Government to present its positions as soon as possible to the Parliament regarding the continued focus of road safety work. The committee further requested that the Government should also investigate and set up an independent road safety inspectorate. Even though these kinds of parliamentary requests are constitutionally non-binding however politically important, the request to set up a road safety inspectorate was delivered by Mr. Rosengren in 2002 (Trafikansvarsutredning 2000; Trafikinspektionsutredningen 2006), and, as mentioned before, it was Ms. Messing who delivered the re-reporting to the Swedish Parliament in 2004 (Swedish Government 2004).

## Policy Stream

The adoption of a new strategy such as Vision Zero is a significant and huge accomplishment, but to also change how road safety measures are implemented in practice is a different thing. To go from policy to implementation has been shown, by some academic researchers, to be a complicated task (Sabatier and Mazmanian 1979; Hill and Hupe 2002; Vedung 1997). In this case it was not only a question of starting new activities based on Vision Zero however also dismantling ineffective activities which were not supported by the new policy. In parallel, when some parts of the Swedish Road Administration were fully occupied with delivering in line with the road safety program adopted in 1995, Director Claes Tingvall with his new road safety team (the road safety unit, an organizational part of the Swedish Road Administration with approximately 15 employees. Tingvall reported directly to the General Director) was primarily occupied with the task to develop new activities, communicate the new direction, and support the Ministry of Communication to develop new policies. A rather unique relationship was established between the Road Safety Unit and the Ministry of Communication. The 1995 road safety program, due to failure to produce road safety result, started to be dismantled around 1998 (Assum and Usterud Hanssen 1999). The road safety unit succeeded to establish in-depth studies of fatal crashes, together with some other international stakeholders; establish European New Car Assessment Program, Euro NCAP, a program to influence the public and private organizations to quality assure their transports in terms of environment and safety; promote urban safety among different municipalities in Sweden; support the largest non-governmental organization for road safety, NTF; reorient their efforts to Vision Zero; start a new system to collect injury data from hospitals; and link the environment with road safety via strategic collaboration, among other efforts. In other words, in the years between 1995 and 1998, several new activities were established, the focus of which was primarily on new processes to influence the various stakeholders in the society. This included the move away from the traditional work to influence the individual road users' behavior to new efforts to influence the system designers. Despite the successful work of the Road Safety Unit in establishing new work processes and cooperation with new actors, the direct output in terms of safety improvements in the road transport system the results were meager. Vision Zero and its strongest representative, the Road Safety Unit, met strong opposition especially within its own organization, the Swedish Road Administration. Sweden had in that time a large state-owned network with 13-meter-wide roads which allowed 90–110 km/h as the maximum speed (Larsson et al. 2002). These had a high mobility; however, many of these were very dangerous and perceived among the public as death roads. Among road engineers, large motorways were regarded as being the best solution to strike appropriate balance between mobility and safety; however, at the same time they were very expensive. Among road safety experts, lowering the speed limits was considered a cost-effective solution but difficult to implement due to low public acceptance. In that context, a new road innovation, referred to as the "2+1 road" was discussed and promoted by the Road Safety Unit. The 2+1 road is probably the best example for how a new policy, a paradigm shift, materializes into a concrete action, but at the same time it challenged the old tradition of road planning and road design. However, Director Tingvall managed to convince the General Director Brandborn to build a pilot project (Larsson et al. 2002) despite strong resistance within the Swedish Road Administration. This was one of the last accomplishments by Director Tingvall before he moved, in the summer of 1998, to Australia and took up a position as the research director at Monash University. Professor Ulf Björnstig (https://www.researchgate.net/profile/Ulf_Bjoernstig), a medical doctor and researcher, replaced Claes as the third Director for Road Safety within the Swedish Road Administration. Within the Swedish Road Administration, efforts had commenced to develop a new national plan for the period 1998–2007 for the road transport system, which also included a special plan on road safety. In the work on the new plan, it became obvious that General Director Brandborn was about to give up the Government road safety target for 2000 and instead focus all efforts on the new target of a 50% reduction by the year 2007. It was not an easy position for the new Director Björnstig, he inherited and had to deal with both internal and external conflicts. In the recommended plan for infrastructure for the period 1998–2007, handed from the Swedish Road Administration to the Government before the end of the year, there was no special investment proposed for 2+1 roads. Director Björnstig developed to the best of his ability, along with staff at the road safety unit, the special road safety plan for the period 1998–2007. The referral edition of the plan was rather comprehensive with proposals such as support for pilot demo projects in urban areas; promoting road safety in procurement practices for transport and for new technology; consumer information such as Euro NCAP, information disseminated to road users especially in matters such as speed, alcohol, and the use of seat belts and bicycle helmets; partial speed limit reductions; winter speed limits; effective enforcement in general; automated speed control; more severe sanctions with speeding; heightened random breath controls; the introduction of ambulance helicopters; a new driving license system; mandatory winter tires; and the Government's intention to make bicycle helmet use mandatory. Together with an earlier presented infrastructure plan, the Swedish Road Administration made the assessment that it was not able to meet the target for 2000 but that the 2007 target was attainable if the Government allocated sufficiently enough resources.

However, as mentioned above, based on the Swedish Road Administration's reports and recommendation and other initiatives, the 11-point program for road safety was developed. Among other things, what most worth of mention is the first point in the program, namely, investment in the most 100 dangerous national roads in Sweden. A second important thing was the announcement that the Government intended to set up a committee of inquiry to clarify and suggest a more formal responsibility for the system designers in line with the overall direction of responsibility, which is stipulated by Vision Zero. However the Government acted only partially in line with the committee's proposal to implement a formal responsibility (Belin 2012). The Government did not adopt any new legislation, but it rather instructed the Swedish Road Administration to incorporate a road safety inspectorate within their organization. The head for the inspectorate Mr. Lars Bergfalk was appointed directly by the Government and reported directly to the board of the Swedish Road Administration, not to the General Director for the Swedish Transport Administration. In 2001, Mr. Brandborn retired, and Mr. Ingemar Skogö (https://en.wikipedia.org/wiki/Ingemar_Skog%C3%B6) became the new General Director. In 2002, Mr. Björnstig resigned, and Mr. Tingvall returned to his former position. The Swedish Road Administration made a major reorganization of its head office in 2002, and the road safety unit was shut down. Soon after the inspectorate started their activities, it delivered harsh criticism particularly against the Swedish Road Administration for lack of a safety culture (Belin 2012).

## Policy Window Opens Up

Despite the strong political support for Vision Zero and its strategies, soon after its adoption dark clouds began to appear in the sky. To go from words to action, e.g., measures for the implementation of Vision Zero, turned out to be more difficult than its proponents had originally expected. Both Ms. Uusmann, within the Swedish Government, and Mr. Tingvall, within the Swedish Road Administration, encountered strong resistance, and when both of them moved to other challenges in 1998, there was a great risk, or if one prefers, a great opportunity, that Vision Zero and its mandated action program would disappear, having flown out of the window or at least would be substantially watered down. However despite Mr. Rosengren's initial hesitation to Vision Zero, the bus crashes in November 1998 and the two crashes in January and February 1999 along with the huge media coverage forced Mr. Rosengren to act. He needed to show political leadership. Furthermore, despite that Ms. Uusmann had left the political scene, the Swedish Standing Committee on Transport and Communications with Ms. Öhman in the forefront was intact and a strong supervisor for Vision Zero and the intermediate target. When we look back in the mirror, it seems like a paradox that a political leader who was perhaps not against

Vision Zero, however, at the least, not a proponent, has most likely become the most important minister when it comes to investments for safety. Instead of approximately SEK 300 million on average per year for the period 1996–1999, the investment increased to an average of SEK 1,888 million per year for 2000–2005. However, most of the interventions in the 11-point program were of long-term nature such as road improvements and initiative of institutional character such as change system designers' responsibility and set up a road safety inspectorate. The 11-point program did not solve the problem. The number of fatalities did not decrease at the rate which is stipulated of the 2007 intermediate target. The road safety inspectorate was not late to point out the lack of progress, and due to media attention and political initiative from the Swedish Standing Committee on Transport and Communications, the Government was forced to act. It was time for a more comprehensive assessment of Vision Zero and its implementation and a discussion about the future direction of the road safety work. Mostly, based on information from the Swedish Road Administration, the Government was confident with Vision Zero and its long-term direction and saw no reason to change its overall policy. However, the Government was more worried about the intermediate target for 2007 and recommended several interventions in order to strengthen the work in order to achieve the intermediate targets such as lower speed limits and increased road user compliance with traffic regulations, especially with automated speed enforcements. The majority in the Swedish Standing Committee on Transport and Communications supported the proposal from the Government; however, the opposition was critical. They were still in favor of Vision Zero as a long-term goal; however, they had strong views on the ways and means to achieve Vision Zero and its short-term targets. Therefore, the unanimous political support for Vision Zero was replaced with a political conflict between a coalition of the Social Democratic Party, Left Party, and Green Party against the Moderate Party, Centre Party, Liberal People's Party, and Christian Democrats. The right wing coalition made a joint reservation and what they were primarily critical about, as they perceived it, was the Government's lack of understanding of the seriousness of the problem and the urgent need for actions. They were especially critical of the Government's failure to develop different financing mechanism such as public and private partnerships. According to the opposition, the probability to reach the 2007 target was non-existent; they recommended therefore that an evaluation should be set up in order to assess the target and the existing road safety work and suggest a new target. The opposition highlighted the need for a mobilization and particular focus also on the individual road users. Although the opposition was unanimous in most of their reservations, some differences could also be discerned – for example, the Moderate Party (Swedish Standing Committee on Transport and Communications 2004) was not too happy about Vision Zero, and they were not in favor of automated speed enforcement in contrast to the Centre Party (Swedish Standing Committee on Transport and Communications 2004). In summary, it was still a great political support for Vision Zero as a long-term goal; however, there were significant political differences of opinion in the appropriate way to move forward (Swedish Government 2004; Swedish Standing Committee on Transport and Communications 2004; Swedish Parliament 2004) (Table 3).

**Table 3** Continued action for safe roads. Vote in the Swedish Parliament on the Committee's proposal against the Moderate, Centre, Liberal, and Christian Parties' reservation on 25 November 2004

| Party | Yes | No | Refrain | Absent |
|---|---|---|---|---|
| The Social Democratic Party | 115 | 0 | 0 | 29 |
| The Moderate Party, Liberal Conservatism | 0 | 42 | 0 | 13 |
| The Centre Party, Centrism, Agrarianism, Social Liberalism | 0 | 18 | 0 | 4 |
| The Liberal People's Party, Social Liberalism | 0 | 34 | 0 | 14 |
| The Christian Democrats, Christian Democracy | 0 | 26 | 0 | 7 |
| The Left Party, Socialism, Feminism | 24 | 0 | 0 | 6 |
| The Green Party | 14 | 0 | 0 | 3 |
| Total | 153 | 120 | | 76 |

## Discussion

In this chapter, Kingdon's (2003) multiple stream model has been applied to two different decision processes about Vision Zero. The long-term development of the road safety problem in Sweden spoke in favor of adopting a Vision Zero policy. Politically one could argue if this trend continues in the future eventually, we will reach zero. Would it be possible to argue in the same way if the trend was more stable or even going in the opposite direction? Probably not, and that might be the reason why other countries were more reluctant to use the word Vision Zero. A safe system, Toward Zero, might be an easier concept to sell politically. However, it might not just be the number itself which is important politically. Vision Zero signals also another ethical attitude towards the problem. Instead of focusing on an aggregated number, Vision Zero is focused on every single human being affected by road trauma. Everyone has the right to safe mobility.

In Sweden, road safety in general and Vision Zero in particular are largely attached to the post-war project to create a modern welfare state and thereby to the Social Democratic Party. Vision Zero is an example of a policy that strives for everyone to have an equal right and access to safety along with governmental responsibility to ensure that all citizens have the same access to and possibility of safe mobility. Even though Vision Zero was proposed by the Social Democratic Party, it generally has substantial support also among the other political parties in the Swedish society, as there is a general agreement for our welfare state. However even though most parties are in favor of and support Vision Zero, it is more uncertain if any another political party would have pursued Vision Zero so strongly as new public policy.

Vision Zero as a concept is very much associated with Professor Tingvall and his expert fellows. However, without political support, his ideas would probably have ended up on a bookshelf. According to Kingdon, basically a window opens because of a change in the political stream or because a new problem captures the attention of governmental officials. It seems that both the political and the problem stream supported the opening of the policy window for Vision Zero. Minister Uusmann's announcement already in January 1995 opened a formal path to develop a new road safety policy, and the positive road safety trend made it possible to discuss Vision Zero rather than simply just seeking to improve the situation. Although both Professor Claes and Ms. Uusmann played key leading roles, it must be noted that they were supported or worked closely with a few policy entrepreneurs within both the Ministry and the public administration to ensure that their ideas were developed and written out. Despite a fast and smooth process and decreasing of controversial proposals, Vision Zero was almost stopped in the last minute in 1997 because of an internal discussion within the Government about Vision Zero and its realism. However, the Government decided to pursue the proposal due to the fact that Vision Zero had already been mentioned in an earlier proposal to the Parliament on road investment. In that proposal, the Government promised to come back and describe Vision Zero in more detail.

Eventually most of the principles that underpin Vision Zero found their way to the final decision in the Parliament, and a new phase in the Vision Zero policy process has begun to transfer overall principles to concrete actions. In line with was predicted by road safety experts, when Sweden started to recover from its economic recession and get back to a normal economic growth, the number of fatalities flattened out and started to increase. Although some activities, mainly of a process character, had been started, the implementation of Vision Zero was not an easy task either politically or among the most important implementation agency, the Swedish Road Administration. The policy window slowly began to close, however was suddenly widely opened due to some tragic events. If this window had opened earlier before the adoption of Vision Zero, the recommendations would have almost certainly only been focused on how to improve the road users' capability to handle minibuses and slippery roads. As a matter of fact, the only recommendation the road safety lead agency, the Swedish Road Administration, suggested was new licensing requirements for driving a minibus (TT 1999). However when the 11-point program on road safety was present in April 1999, the first action point was dedicated to road safety investment on the state road network. The policy initiative was moved from the lead agency to the highest political level, and the recommendation came from the outside. Even an insurance company, Folksam, pushed for more investment in the 2+1 roads (TT 1999). Most of the recommendations in the 11-point program were of long-term nature, and despite significant amounts of micro-successes where a middle barrier was put up, it was still a small part of the network in the beginning of 2000. Therefore, due to the problem stream and political pressure from the Swedish Standing Committee on Transport and Communications, road safety stayed as a topic on the agenda and forced the Government to ask the Swedish Parliament for new trust in Vision Zero and its stipulated way to eventually achieve a safe road transport system. Even though the Government still had a strong political support for Vision Zero as a long-term goal, there was less political support how this long-term goal should be achieved and if and what interventions are needed to be put in place in order to attain the intermediate target for 2007. Thus, it seems that road safety politics is not about goals but rather more about how these goals and intermediate targets should be accomplished. Despite some differences in nuance, all political parties agreed upon a stronger focus on individual road user behavior in order to achieve Vision Zero and short-term targets. This is a potential challenge to one of the core aspects of Vision Zero, namely, it is the system designers who are overall responsible for road safety. The biggest difference between the different parties seemed to be how important speed interventions are, compared to investment in infrastructure. The Government with support of the Left Party and the Green Party seems to be more in favor of speed reduction intervention. The right wing parties would instead like to see more investments. It seems that the road safety measures that the political parties prefer and prioritize have a strong correlation with other transport policy priorities. If the political parties put more emphasis on environment, there is a tendency to assign a higher priority to speed reduction interventions. If the political parties give more priority to mobility, primarily for motorized traffic, it is a tendency to prefer investments. Based on these analyses of two political decision processes, it could be concluded that there is a strong political consensus about Vision Zero; however, the path forward is highly sensitive, at least in the short run, and what route to choose depends very much on other transport policy goals. Therefore it is a risk that safety becomes a pseudo argument for something else. For example, motorways are comparatively safe however also good from a mobility perspective. However they are very expensive, and the same safety level could be reach with the 2+1 roads. Increasing the compliance of speed limits will improve the safety and also improve the air quality; however, this solution might not be a solution for a safe system without any health losses in the long run. The ongoing Vision Zero policy process is summarized in Fig. 3.

## Epilogue

The target for 2007 to halve the number of fatalities from 1998 was missed by more than 200 fatalities, compared to what the target stipulated. In 2006, the Social Democrat Party was voted out of office, and Mr. Fredrik Reinfeldt (https://en.wikipedia.org/wiki/Fredrik_Reinfeldt), leader of the Moderate Party, becomes Prime Minister, and for the first time since 1991, a center-right wing Government was set up. Ms. Åsa Torstensson (https://en.wikipedia.org/wiki/%C3%85sa_Torstensson), from the Centre Party, became Minister for Infrastructure. The road safety work was evaluated thoroughly (Breen et al. 2007; Swedish Road Administration 2008) however politically, even with the new center-right wing Government who when they were in the opposition had been critical of the former Government and its policies, retained Vision Zero as a long-term goal and they concluded, among other things, that Sweden is in the ‘establishment’ phase of its journey towards Vision Zero. The next challenge, in view of Sweden’s highly ambitious goal, is to achieve rapid ‘growth’ in the delivery of accountable, well-orchestrated, and effective Vision Zero activity. In addition a new intermediate target for 2020 was adopted – a 50% reduction which meant no more than 270 fatalities per year by 2020. Despite the failure to attain the intermediate 2007 target, from 2002 until about 2013, Sweden

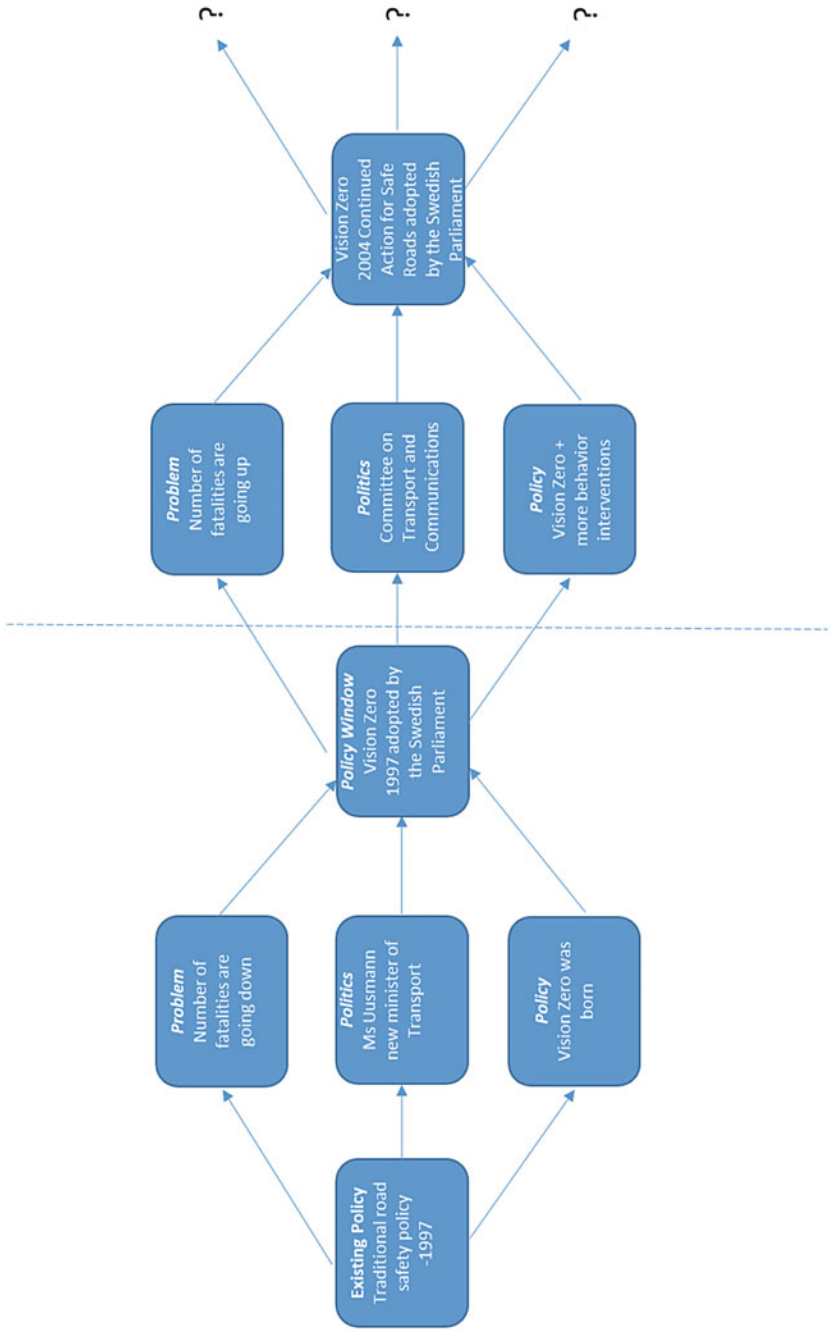


**Fig. 3** Vision Zero a continuous public policy process

experienced a downward trend, and the number of fatalities was reduced by more than 50%. Investment in the 2+1 roads, automated traffic safety cameras, lower speed limits, and safer vehicles, together with other interventions, contributed to this downgoing trend (Fridtjof and Vadeby 2007; Strandroth 2015). However, even though Sweden was affected to a lesser extent by international standards, the economic crisis of 2008 and adjustment of the official statistics to separately report suicides in 2010 also contributed to this positive trend. Fairly immediately after the new Government took office in 2006, they initiated a large organizational reform work in the transport sector. This work seems to be guided on at least three important principles, integrated transport system, strict Government mandate, and market-driven production (Swedish Transport Administration 2015). First out was the formation of the Swedish Transport Agency responsible for regulation and inspection activities of all transport modes. The Swedish Transport Administration responsible for planning of the whole transport system and building and maintaining road and railway infrastructure was set up in 2010. Probably due to the fact that road safety was continuously improved, Vision Zero and how to organize an effective institutional arrangement for safety were not on the reform agenda. Even the road safety inspectorate, which was a fairly new organization, was dissolved. No lead agency for safety was designated or pointed out by the Government. In 2014, the Social Democratic Party returned to power however this time together in a Government collaboration relying on the Green Party. This new Government had a rather weak position within the Parliament, and when the whole opposition was united they could topple the Government. Since 2010, there was a tendency that the steady downward trend was plateauing, and the new Government decided to draft a new policy document, renewing their commitment to Vision Zero. In 2016, the Government announced its decision to re-launch Vision Zero (Swedish Government 2016), an intensified initiative for transport safety in Sweden. Based on this policy document, they also commissioned the Swedish Transport Administration to leading the road safety collaboration to achieve Vision Zero. This is the first more comprehensive discussion about Vision Zero and its direction from the Government since 2004. However this new policy document was never directly formulated into a Governmental proposal and sent to the Parliament for consideration. The reason for this might be that the Government would like to avoid the risk that this strategy would end up as a political discussion in the Parliament which they could lose. In any event, this is an important step in an ongoing policy process in the shaping of Vision Zero as a public policy and its implementation.

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# 9 Vision Zero in Norway

Rune Elvik

## Contents



**Abstract**

This chapter describes the adoption of Vision Zero in Norway and some of the impacts on transport safety policy that can be traced to it. These impacts concern the following:

1. the demand for improved knowledge about the effects of road safety measures,
2. the creation of a new forum for developing road safety policy,
3. the adoption of quantified road safety targets and a system for management by objectives based on road safety indicators,
4. the identification of roads suitable for conversion to motorways or to 2+1 roads based on the Swedish model,
5. the revision of speed limit policy and
6. the revision of standards for the design and use of guardrails.

R. Elvik (✉)
Department of Safety and Security, Institute of Transport Economics, Oslo, Norway
e-mail: rune.elvik@toi.no



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It is argued that the adoption of Vision Zero has had a major impact on road safety policy in Norway and may have contributed to speeding up the decline in the number of traffic fatalities and serious injuries after the year 2000.

**Keywords**

Norway · Quantified targets · Policymaking · Fatality trends · Evidence base

## Introduction

In 2000, the National Transport Plan for Norway for the term 2002–2011 was presented. The plan was the first of its kind, i.e. the first long-term plan that included all modes of transport. Previously, separate plans had been made for each mode of transport, with no attempt to coordinate policy for all modes of transport. In the National Transport Plan (Samferdselsdepartementet 2000), the Ministry of Transport stated:

> The Ministry will give higher priority to road safety measures in the 2002–2011 planning term. The basis for doing so is a vision of no fatalities or permanent injuries in road traffic.

Before the adoption in The Parliament (Stortinget), the Transport and Communication Committee stated (Stortinget 2001):

> The Committee notes that the Government will base road safety policy on a vision of no fatalities or permanent injuries in road traffic. The Committee shares this vision.

Stortinget approved Vision Zero in February 2001 as part of the first National Transport Plan (Stortinget 2001). It has later been clarified that Vision Zero applies to all modes of transport in Norway. Vision Zero has unanimous political support. All political parties endorse it.

## Fatality Trends Before and After Vision Zero

Figure 1 shows the annual number of traffic fatalities in Norway from 1970 to 2019. The highest number ever recorded was 560 in 1970. In the years before the adoption of Vision Zero, there was an irregular downward trend, corresponding to a mean annual decline of 2.1% in the number of fatalities.

After the adoption of Vision Zero, the annual decline in the number of traffic fatalities in Norway has accelerated to 6.1%. The lowest number of fatalities recorded before the adoption of Vision Zero was 255 in 1996. In the 19 years from 2001 to 2019, the number of fatalities has been lower than 255 in 14 years, including all years after 2008.

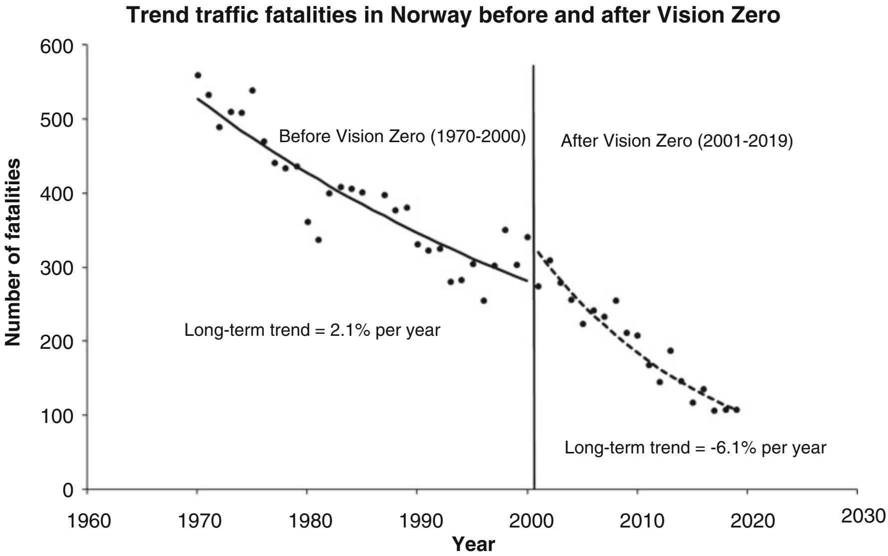


**Fig. 1** Trend in traffic fatalities in Norway before and after Vision Zero

Obviously, these numbers by themselves prove nothing. However, they at least show that progress in improving road safety in Norway speeded up after Vision Zero became the long-term ideal for transport safety. It may be noted that the annual trend in the period before the adoption of Vision Zero was the same, a decline of 2.1% per year, even if the trend refers to data for the last 19 years of the period, 1982–2000, rather than 1970–2000. Is it possible to identify specific policies or measures taken that may explain the more rapid decline in fatalities after 2001 than before?

## Demand for Updated Knowledge

The Institute of Transport Economics published the first edition of the *Handbook of Road Safety Measures* (Pedersen et al. 1982) in 1982. Updated editions were published in 1989, 1997 and 2012. Since 2000, an online edition of the *Handbook* is continuously being updated. To make road safety policy more evidence-based, the *Handbook* has been supplemented by a report written specifically to serve as input in the development and revision of the National Transport Plan, a catalogue of effective road safety measures. The catalogue of measures was, in its current form, first published in 2002 (Elvik and Rydningen 2002). Updated editions were published in 2006 (Erke and Elvik 2006), 2011 (Høye et al. 2011) and 2017 (Høye 2017).

This means that updated estimates of the effects of road safety measures are now systematically produced to serve as a basis for planning these measures. Particular emphasis is put on showing effects on fatalities and serious injuries, as these are the types of injuries that Vision Zero seeks to eliminate. The regular updating of the catalogue of effective road safety measures provides a basis for an evidence-based road safety policy. Many of the road safety measures implemented after 2001 have clearly been evidence-based; at the same time, some measures for which evidence of effects is less clear continue to be used (more on this in the next section).

## A New Forum for Road Safety Policymaking

The National Transport Plan does not describe road safety measures in great detail. Moreover, it includes only measures for which road authorities are responsible, not education and training or police enforcement. A need was therefore felt for creating a new forum for road safety policymaking in addition to the system set up for developing the National Transport Plan.

Starting in 2002, detailed road safety programmes for four years have been developed as a supplement to the National Transport Plan. The lead agency for developing and following up of the plan is the Norwegian Public Roads Administration. The current plan, covering the years 2018–2021 comprises 136 road safety measures (Statens vegvesen et al. 2018). The plan has been developed by the Public Roads Administration, the Police, the Norwegian Council for Road Safety, the Directorate of health, the Directorate of education, the Association of municipalities and representatives of large cities and counties in Norway. All these bodies have signed the plan. Implementation is monitored annually.

The plan embodies the system of management by objectives created for road safety in Norway. This system is presented in the next section. The measures included in the current road safety plan are a mixture of very specific measures for which expected impacts can be estimated and more general measures whose effects are more difficult to quantify. Examples of measures belonging to the first group are as follows:

> Measure 101: During 2018–2021 approximately 192 km of four lane divided motorways will be built.
>
> Measure 102: During 2018–2021 median guardrails will be installed on 40 km of road with two or three lanes.

Examples of measures of a more abstract nature include the following:

> Measure 17: The police will consider using the method “conversations about matters of concern” together with municipal social workers as an element of advice to and treatment of repeat offenders.
>
> Measure 123: Counties and major cities will encourage active cooperation between public agencies and organisations in order to join forces and work towards improving road safety at the regional and local levels.

While these measures may have value, they are somewhat vague and non-committal (the police will 'consider'; counties and major cities will 'encourage'), and the results expected by implementing the measures are not described.

It is nevertheless reasonable to assume that, by (1) establishing a broad consensus on road safety policy, (2) involving as many stakeholders as possible, (3) asking each stakeholder to commit itself to implementing at least one road safety measure and (4) establishing annual monitoring of progress, it becomes more likely that effective road safety measures will be implemented than if road safety policy lacks one or more of these elements.

## Quantified Road Safety Targets and Management by Objectives

For a long time, Norwegian politicians were opposed to setting quantified targets for reducing the number of fatalities and serious injuries. This has changed after the adoption of Vision Zero. In the most recent National Transport Plan (2018–2029), a target has been set of reducing the number of killed or seriously injured road users to a maximum of 350 by 2030. Figure 2 shows the actual number of killed or seriously injured road users registered by the police from 2000 to 2019 and the targeted decline until 2030.

There were 673 killed or seriously injured road users in 2019. The target for 2024 is a maximum of 500 and the target for 2030 a maximum of 350. As can be seen from Fig. 2, the recorded number of killed or seriously injured road users during 2014 to

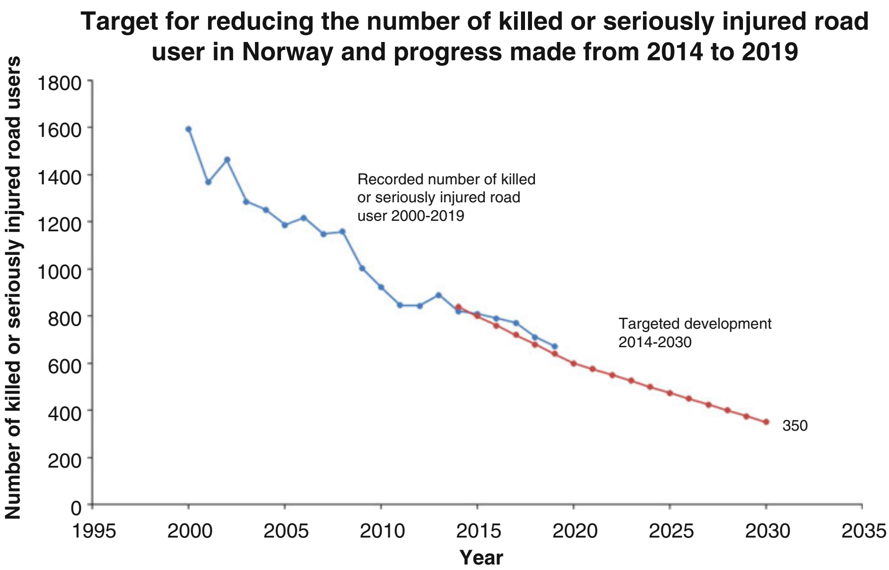


**Fig. 2** Quantified road safety target for Norway for 2030

2019 was slightly above the target numbers. The trend is, however, closely parallel to the targeted development.

In addition to the overall target for reducing the number of killed or seriously injured road users, a comprehensive set of safety performance targets has been set based on safety indicators. These targets include amongst others compliance with speed limits, compliance with blood alcohol limits, seat belt wearing, wearing of bicycle helmets and use of reflective devices. These targets reflect high ambitions for improving road safety, and progress has been made in realising some of them. More specifically, compliance with speed limits has increased from 45.6% in 2006 to 62.1% in 2019 (Statens vegvesen et al. 2020). Seat belt wearing in front seats of passenger cars has increased from 89.8% in 2004 to 97.4% in 2019. However, it should be noted that (1) there are very many targets and (2) it is not always clear what action must be taken to realise the targets (Elvik 2008). The guidance provided by the system of management by objectives could be enhanced if, for each target, an analysis of the measures that should be implemented to realise the target was also included.

## Converting Roads to Motorways or 2+1 Roads

An innovative road safety measure, inspired by Vision Zero and first tested in Sweden, is 2+1 roads. When Vision Zero was adopted in Norway, an inventory was made of roads that could either be converted to motorways or to 2+1 roads. The 2+1 solution was judged as suitable for 1340 km of road, of which 340 km had been built by the end of 2018 (Statens vegvesen 2019). Motorways (four-lane divided roads) were judged as suitable for 1100 km of road (this included motorways that had already been built). The building of motorways has expanded considerably in Norway after Vision Zero was adopted. Figure 3 shows how the length of motorways has developed from 1962 to 2018.

It is seen that growth in motorway length has been more rapid after 2000 than before. The rapid growth in the length of motorways will continue in the coming years. An evaluation study (Elvik et al. 2017) concluded that a new motorway in the county of Østfold reduced the number of fatalities and serious injuries by 75%.

2+1 roads are considerably more difficult to build in Norway than in Sweden. Sweden had a large network of the so-called “13 metre” roads that could easily be converted to 2+1 roads by means of road markings and wire guardrails. Norwegian roads are narrower. To allow for 2+1 lanes, most of these roads need to be widened, which adds to the cost and complexity of the projects. There are median guardrails on a few two-lane roads, but the use of median guardrails on two-lane roads is restrictive, as there is a risk that the roads gets blocked in case of an accident, making it difficult for police and rescue services to get to the site of the accident.

## New Speed Limit Policy

According to the biomechanical foundations of Vision Zero, speed limits should be no higher than 30 km/h in places where pedestrians can be struck by motor vehicles, no higher than 50 km/h in places where side impacts between cars of equal mass may

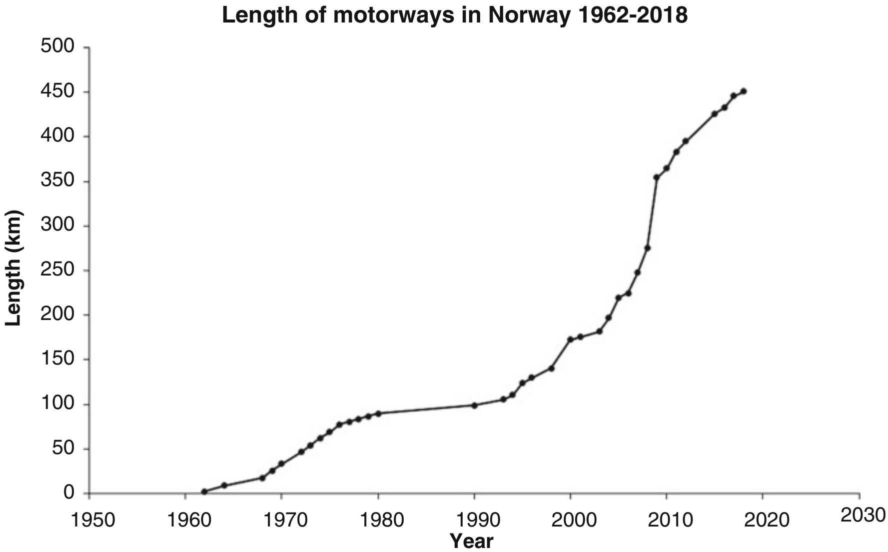


**Fig. 3** Length of motorways in Norway 1962–2018

occur (junctions) and no higher than 70 km/h in places where frontal impacts between cars of equal mass may occur. On roads where there are no pedestrians or cyclists, no at-grade junctions and a physical separation or safety barrier between opposite directions of travel, Vision Zero allows for higher speed limits, like 90 km/h or more. When Vision Zero was adopted in Norway, speed limits were 50 km/h in urban areas and 80 km/h outside urban areas.

A review of speed limit policy was initiated. As a basis for the review, a new approach to estimating road safety was introduced. This was the empirical Bayes approach to road safety estimation, based on accident prediction models first developed in 2002 (Ragnøy et al. 2002) and updated in 2014 (Høye 2014) and 2016 (Høye 2016). Road sections that had a high expected number of fatal or serious injury accidents were identified. In 2001, speed limits were lowered on these road sections, from 90 to 80 km/h on 393 km of road and from 80 to 70 km/h on 741 km of road (Ragnøy 2004; Christensen and Ragnøy 2007). The mean speed of traffic was reduced, respectively, from 85.1 to 82.2 km/h and from 75.3 to 71.2 km/h. The number of fatalities was reduced by 34% on roads where the speed limit was lowered from 90 to 80 km/h and by 29% on roads where the speed limit was lowered from 80 to 70 km/h. It can be estimated that lowering the speed limit from 80 to 70 km/h reduced the annual number of fatalities by about 7. The reduction of the speed limit from 90 to 80 km/h was estimated to reduce the annual number of fatalities by about 2. The use of 70 km/h on rural road sections with a high expected number of fatal or serious injury accidents is now an integrated part of speed limit policy in Norway.

Speed limits of 30 or 40 km/h are increasingly introduced in urban areas (Bjørnskau and Amundsen 2015). On some motorways, speed limits have been increased from 90 to 100 or 110 km/h. There has been a tendency for the mean speed of traffic to go down in Norway after 2006. Based on updated estimates of the relationship between speed and road safety (Elvik et al. 2019), the tendency for speed to go down may have reduced the number of fatalities by close to 20% from 2006 to 2019.

## Criteria and Design Standards for Guardrails

An important element of roads that came under scrutiny early following the adoption of Vision Zero was guardrails. Formal criteria for the use and design of guardrails have long existed. In 2001, a research project was carried out to revise these criteria (Elvik 2001). The criteria for using guardrails were liberalised, meaning that installing guardrails would be warranted at more sites with the new criteria than with the old.

An important change in the design guidelines concerned guardrail end design. Before the change, the most common design in Norway was the so-called turned down design, shown in Fig. 4 (Gjerde 2008). This design could act as a launching pad for a striking car. The car would climb up the slope of the guardrail and be launched into the air, landing perhaps far away from the point where the guardrail was struck. This design of guardrail terminals has been found to be associated with a high share of fatal and serious injuries (Elvik 2001).

As a result of the revision of the design standards for guardrails in Norway in 2001, the turned down design is no longer permitted on new roads or when replacing

**Fig. 4** Turned down guardrail terminal. (Photo: Marianne Gjerde (2008))

**Fig. 5** Flared out guardrail terminal attached to backslope. (Photo: Marianne Gjerde (2008))

guardrails on existing roads in rural areas. Guardrail ends should be flared out and attached to a backslope or designed to redirect a vehicle to a safe zone outside the road. This design is shown in Fig. 5.

## Other Developments

There have been a number of other developments in road safety policy in Norway after 2001 that most likely have contributed to reducing the number of killed or seriously injured road users. The use of speed cameras and section control (two or more connected speed cameras monitoring a road section) has expanded. These measures are highly effective in reducing the number of killed or seriously injured road users (Høye 2015a, b).

Per se limits for the concentration in blood of medicines and illegal drugs were introduced in 2012 and expanded in 2016. Roadside surveys (Furuhaugen et al. 2018) show that the amount of driving with illegal concentrations of medicines or illegal drugs was reduced from 2009 to 2017.

In-depth studies of fatal crashes started in 2005 and are made both by the Public Roads Administration and the Accident Investigation Board of Norway. The reports on fatal crashes contain recommendations for safety measures, whose implementation may reduce the chances of similar crashes in the future.

A Road Safety Inspectorate was created in 2012. Its mandate is to monitor the compliance with safety standards for roads, as given, for example, in design standards and guidelines for the use of traffic control devices. It publishes inspection reports where deviations from safety standards are noted and recommendations for improving compliance are given.

## Discussion and Conclusions

When Norway adopted Vision Zero in 2000–2001, progress in improving transport safety appeared to have stagnated. The number of road traffic fatalities in 2000 was 341, the second highest number in 10 years and considerably higher than the annual average for 1990–1999, which was 306. A major ferry accident in late 1999 killed 16 people. A major train crash in early 2000 killed 19 people. The crash of a Russian flight on Svalbard in 1996, killing 141 people (all of whom were Russian mine workers), was still fresh in memory. A pressure was felt for taking bold initiatives to reinvigorate transport safety policy.

Sweden had adopted Vision Zero in 1997, and doing the same in Norway was widely regarded as an attractive idea. When the Ministry of Transport proposed to adopt Vision Zero as the long-term ideal for transport safety, there was unanimous political support for this. Within the two first years, this had an impact on speed limit policy and on criteria for use and design of guardrails. Other policy innovations took somewhat longer to materialise. The four-year road safety programme was first developed in 2002. The system of road safety management by objectives was developed at the same time, but quantified targets for reducing the number of fatalities and serious injuries did initially not get political support. A quantified target for reducing fatalities and serious injuries was approved in the National Transport Plan for the 2010–2019 term and has had political support since then.

On the whole, after the adoption of Vision Zero, road safety policy has become more evidence-based, based on quantified targets, based on a more detailed planning of road safety measures and embedded in an institutional framework ensuring consensus on goals and measures. Was this just a coincidence or was it brought about by the adoption of Vision Zero? History, unfortunately, does not produce a control group. It is impossible to know what would have happened in Norway if Vision Zero had not been adopted. It is a fact that road safety in Norway has been greatly improved after 2000. A complete account of the factors contributing to this improvement cannot be given. However, it is not unreasonable to think that it can, at least in part, be credited to a better-informed road safety policy, inspired by Vision Zero.

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# Sustainable Safety: A Short History of a Safe System Approach in the Netherlands 10

Fred Wegman, Letty Aarts, and Peter van der Knaap

## Contents



**Abstract**

Although it has never been a real top priority, road safety is an important issue in the Netherlands and much progress has been made. In the last 50 years, the country experienced an enormous growth in population (+30%) and in kilometers travelled (+300%), but the mortality rate dropped by 80%. Many effective interventions were taken. Over time, new insights in traffic risks and causes of crashes led to the adoption of a new road safety vision in the early 1990s: Sustainable Safety, the first attempt worldwide of a Safe System approach (1992). This vision was inspired by the UN-Brundtland report Our Common

F. Wegman (✉)
Department of Transport and Planning, Delft University of Technology, Civil Engineering and Geosciences, Delft, The Netherlands
e-mail: f.c.m.wegman@tudelft.nl

L. Aarts
SWOV Institute for Road Safety Research, The Hague, The Netherlands
e-mail: letty.aarts@swov.nl

P. van der Knaap
The Hague, The Netherlands



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Future (1987) and applied to road safety. Its basis originated in the knowledge and experiences in the decades before.

In a sustainably safe road transport system, risks of crashes and serious injuries are drastically reduced or even eliminated by an infrastructure that is adapted to the limitations of human capacity by proper road design, by vehicles fitted with ways to simplify the tasks of man and constructed to protect the vulnerable human being as effectively as possible, and by road users who are adequately educated, informed, and, where necessary, controlled. If crashes still do occur, serious injuries must be excluded. The vision Sustainable Safety has been translated into a set of characteristics and into Sustainable Safety principles.

Sustainable Safety was welcomed by Dutch road safety professionals and received great political support. A massive implementation program was initiated and carried out as from 1995. Many stakeholders were engaged. An evaluation study covering the period 1998–2007 revealed a 30% reduction in the number of fatalities. Benefits of the investments were four times higher than costs. Sustainable Safety empowered and strengthened the Dutch road safety research community and heavily influenced the discourse on road safety in the country.

As from 2000, several developments (a different planning structure of road transport, less political priority for road safety – perhaps as a result of successes in the past – and decentralization of policies) caused that Sustainable Safety became less prominent and safety effects less visible. However, the vison and the principles remain a solid basis for making progress towards a casualty-free road transport system and to respond to new developments, such as a changing demography, changing transport modes and traffic patterns, and new technologies. Two more editions have been published (2005 and 2018). Results and impacts are being discussed.

**Keywords**

Safe system approach · Crash causation · Safe system principles · The Netherlands · Implementation

## Introduction

The rapid reconstruction of the Netherlands after World War II was accompanied by an annual economy growth of about 4% (1950–1975). A similar growth was also to be observed in other Western European countries. This prosperity growth was accompanied by a growth in car mobility. On a population of ten million, the number of passenger cars increased from about 150,000 in 1950 to 500,000 in 1960, and to nearly 2.5 million vehicles on a 13 million population in 1970 (Harris 1989). The number of cars has now grown to 8.5 million, which means that 1 in 2 people in the Netherlands owns and drives a car.

In the twentieth century, the main transport modes in the Netherlands were cycling, walking, or public transport, but gradually the car took over public space.

The Netherlands has traditionally been a bicycle country and now has more bicycles than inhabitants: there are 23 million bicycles on a 17 million population. Almost 40% of the bicycle kilometers are for recreation and sport; the remaining more than 60% are for commuting, cycling to and from school (the vast majority of high school students – 12–18 years old – cycle to school), and for shopping (Harms and Kansen 2018). In 1950, one in two Dutch people owned a bicycle and that share remained constant until well into the 1960s. The passenger car became increasingly popular during this period and displaced the bicycle. Somewhat exaggerated we could say that in the 1960s, the bicycle was only used by those who could not or were not allowed to drive a car: school children, housewives, elderly, and those who did not (yet) have a driving license.

The growing popularity of the car led to a demand for more space for cars. This was found in expanding the street and road network, particularly the extension of the motorway network. The length of the motorway network enjoyed explosive growth and, in the densely populated Netherlands, is longer per square kilometer more than anywhere in the world. After the British motorways, the motorways in the Netherlands are the most heavily used worldwide.

But remarkably, public space being increasingly dominated by passenger cars led to a social reaction as early as the early 1970s. The car required more space (for driving and parking), but in the historic cities of the Netherlands (which experienced spectacular growth in the seventeenth century, when the Netherlands was an economic and political "world power"), the extra physical space could hardly be found and citizens were increasingly opposed to making the necessary changes. The tension between traffic and livability in towns and villages became an issue. It was the period in which civil society organizations did not want to subject to the passenger car becoming increasingly dominant, at the expense of the space for cyclist and pedestrian. Organizations dedicated to making school routes and the school environment safer could count on strong support. It was the period when cities prioritized the use of public transport and a start was made with the construction of tram and bus lanes. It was the period when "woonerf's" were created in the Netherlands, later followed by traffic calming (30 km/h) zones. The social developments outlined here were certainly not dominated by road safety considerations, but they certainly played a role.

Recent decades have been characterized by further growth in mobility, although the growth rate has fallen significantly and we observe hardly any growth in the last decade (KiM 2019). Congestion, particularly on the motorways, is perceived as worrying, but by citizens do not consider congestion as a major problem in Dutch society (KiM 2020). The Netherlands is a country of cyclists with more bicycles (23 million) than inhabitants (17 million). More than 25% of all trips are cycle trips (Harms and Kansen 2018). Separate cycling facilities are very popular and the expansion of these facilities, both within and outside cities, is impressive (Harms and Kansen 2018). Use of public transport was growing with 10% between 2010 and 2018 (KiM 2019). Freight transport by road increased dramatically over the years, with, for example, by almost 50% in kilometers travelled between 1999 and 2008 (Tavasszy and Ruijgrok 2013) and 12% between 2010 and 2018 (KiM 2019).

This is the context in which the history of road safety in the Netherlands is studied: a country with high population density, a high-quality and greatly expanded road infrastructure, where the available space is shared by motorized traffic, vulnerable road users (pedestrians and cyclists), and public transport. Road congestion, environmental problems (emissions and noise), and road safety require political attention and funding. This chapter discusses road safety development in this drastically changing road transport environment in recent decades.

This chapter starts with a brief outline of road safety in the Netherlands. We will then go deeper into the causes of road crashes as an introduction (and explanation) of the Netherlands opting for a Safe System approach in the late 1980s/early 1990s. In the Netherlands, the name Sustainable Safety was given to this approach. The Sustainable Safety vision will then be discussed according to the three editions of the vision that have so far been developed and published (1992, 2005/2006, and 2018). The development, as well as the implementation and evaluation results of the vision will be discussed. The chapter concludes with a reflection on almost 30 years of Sustainable Safety in the Netherlands.

## Road Safety in the Netherlands: A Success Story

The number of road fatalities increased from about 1000 road deaths in 1950 to 3264 fatalities in 1972, a record height. This negative development was certainly cause for concern in Dutch society. It is striking that it was not the government that called for action, but civil society organizations, particularly the Dutch Touring Club ANWB (Bax 2011). The government did not join until later. This striking phenomenon is not so easy to explain. The following reasoning may, however, be plausible: the growth of motorization was considered a positive development because it went hand in hand with an intended growth of prosperity and well-being among the Dutch population. Negative consequences such as the growth in the number of road crashes and the number of road casualties were considered an unavoidable price that had to be paid.

In addition, there may have been another argument for the government not to intervene. It was generally accepted that road crashes were dramatic, but exceptional incidents, the cause of which was to be found mainly in humans who were inattentive and careless. More careful behavior was believed to result in fewer crashes (Asmussen 1983). Campaigns were used to call on the Dutch road user to act as “A gentleman in traffic” and thus to contribute to reducing the number of road casualties. Until the 1970s, a classic difference of understanding can be observed between “left-wing” and “right-wing” politicians: the political “right” primarily considered road crashes as a responsibility of the individual. Policy should call on road users to take that responsibility using laws and regulations and their enforcement. There was limited need for intervention from the government. The political “left” saw road crashes as a problem for vulnerable citizens (pedestrians and cyclists) who suffered from the behavior of “strong road users,” mainly drivers of passenger vehicles.

In the 1960s and 1970s, the scale of the problem of road safety certainly became clear in the Netherlands and a multitude of activities were developed to improve the situation. It is remarkable, however, that in a comparison between Sweden, the United Kingdom, and the Netherlands (the SUN countries, the best-performing countries in the world in the field of road safety) which was carried out in the SUNflower project (Koornstra et al. 2002), the Netherlands had a mortality rate of around 25 road deaths per 100,000 inhabitants and Sweden and the United Kingdom of around 15. This difference was eliminated in the following 20 years. There are a couple of possible explanations: the Netherlands was rather late to improve road safety or, secondly, road safety policy in the period 1970–1990 was more successful in the Netherlands than in both other countries. We tend to the first explanation, but whatever the explanation: in the period 1970–1990, the number of road deaths, mortality (deaths per 100,000 inhabitants), and traffic risk (deaths per motor vehicle-kms travelled) decreased significantly (60% fewer annual road deaths in 20 years). A third explanation, however, might be that the introduction of mandatory helmet use for riders of motorized two-wheelers (1972/1975) reduced not only the risk to be injured but also the exposure. In a relatively short period of time, the number of mopeds decreased with two-thirds, as did the number of moped fatalities (SWOV 2007).

During the same period (1970–1990), the policy interest in road safety increased considerably which was mainly reflected in a substantial amount of legislation (alcohol, speed limits, seat belts, helmets for motorcyclists and moped riders). A separate Road Safety Agency was set up at the national level, after an initiative from Dutch Parliament, a Road Crash Registration Department was established within that Agency and an independent Road Safety Council, led by Prof. Pieter van Vollenhoven, was established. Through an annual government subsidy, SWOV also acquired considerable leverage and acted as a driving force to support road safety policies.

In the late 1980s, however, the decrease in the number of road deaths did not continue and new initiatives were considered necessary. The national government drew up strategic plans with great frequency. It is worth noting that one of those plans announced that it was necessary to work with a quantitative target (−25% for the period 1985–2000). Not much later, it was decided to aim for −50% in the period 1986–2010. Road safety was on the rise in the Netherlands. In 1989, a book (Wegman et al. 1989) was published which drew up the balance of a large number of road safety issues. It also indicated where further profits could be made. However, one of the comments was that these were all isolated road safety issues and proposed measures that lacked a fundamental understanding of road crashes. Road safety plans at the time were basically a long list of individual measures and interventions. There was no cohesion between the various road safety issues and interventions and they also lacked a general vision of how proposed measures could be effectively implemented.

In this period (the late 1980s), road safety was given less policy priority by the Dutch government. This might be related to the impressive reduction in the number of road casualties in the 1970s/1980s after which policy attention could shift and actually did shift to other issues, such as combating congestion. In an interview in the staff magazine of the Ministry of Transport and Water Management in May 1992, the then director of road safety in the Netherlands, Paul Hamelynck, says: “In the notes and speeches that end up on my desk, my field gets too little attention. In a whole series of notes on traffic and transport, I didn’t even once come across the word road safety.”

SWOV Institute for Road Safety Research was then invited by the Ministry’s Road Safety Agency to develop a new vision for a road safety approach. Three issues were to be central to this vision: an in-depth analysis of why traffic leads to so many annual traffic casualties (numbers that are considered unacceptable in other transport modes such as rail transport and aviation), a vision of what significantly safer road traffic might look like, and, finally, along which lines that significantly safer road traffic could be established. Informal contacts with Swedish colleagues working on Vision Zero was a source of inspiration for both countries.

SWOV decided not to carry out this work by itself but enlisted the help of other researchers. Practitioners and representatives of government and interest organizations were invited to support this process. And together, they created a first version of a “System Approach” for road safety. The published book was named “Naar een Duurzaam Veilig Wegverkeer; Nationale verkeersveiligheidsverkenning 1990/2010” (Towards a Sustainably Safe Road Traffic; National Road Safety Outlook 1990/2010). The book was also referred to as the “Purple book,” due to the color of the cover. During the years 1990/1992, a large number of people worked on this book, and it was published on the occasion of SWOV’s 30th anniversary. It is noteworthy that the Road Safety Policy Plan which was released in 1991 (note, one year earlier!) introduced Sustainable Safety as one of the policy pillars, alongside six traditional spearheads for policy (driving under the influence of alcohol, safety devices such as seatbelts, airbags, child seats, and crash helmets, speed, hazardous situations (high-risk locations), cyclists, and heavy traffic). The authors of the Policy Plan could take a sneak preview!!

Before introducing Sustainable Safety, it is useful to take a closer look at how crash causation was looked at over the years, also in the perspective of crash prevention. This is of interest because Sustainable Safety set out to introduce a new way of thinking about crash causation and crash and injury prevention, based on literature on risk management (for example, by Jens Rasmussen) and human factors (Reason 1990). In the course of the previous century, the thoughts on road crash causation did certainly not remain unchanged. Thinking about this was crucial in developing the new vision.

## Causes of Crashes

A rather comprehensive description of various road safety paradigms in the twentieth century can be found in an OECD report (OECD 1997). The concept of paradigms and paradigm shifts has been introduced by Thomas Kuhn in his 1962 publication “The Structure of Scientific Revolutions” (Kuhn 1962). He defines a paradigm shift as a fundamental change in the basic concepts and experimental practices of a scientific discipline. The concept of paradigm shift is certainly applicable when it comes to road safety. The OECD paradigms for road safety were later used in, for example, a history of road safety research (Hagenzieker et al. 2014; Hakkert and Gitelman 2014). The OECD classification has also been supplemented in order to characterize crash causation as used in road safety policies over a certain period of time. The four paradigms in the OECD report are: (1) crashes as chance phenomenon, (2) crashes caused by the crash-prone, (3) crashes are monocausal, and (4) crashes are multicausal. Two paradigms were added to these original four (Wegman et al. 2007): (5) "the road user is the weakest link and road user behaviour can be changed by education/enforcement." The sixth paradigm is the Safe System's management perspective.

According to the OECD report (1997), early last century road crashes were considered an unfortunate incident in which the person concerned had the misfortune to be involved in a crash. Attempts were hardly made to prevent crashes. In the following period (1920–1950), crashes were attributed to persons who were unfit for traffic participation. The notion of crash-prone drivers was introduced and road safety improvement was considered a matter of making this (small) group of road users perform better. From 1950 onwards, the perspective was widened with the notion that crashes were the consequence of one single cause: either the road user, or the vehicle or the road. From 1960, it was increasingly being recognized that multiple causes can play a role in one crash and that crashes and injuries can be prevented by taking all possibilities into consideration. From the 1970s, a revival of "the road user is the weakest link" could be observed and more training, education, and enforcement of rules were believed to be the solution. This also contributed to a more integral approach being followed from 1990 onward: multiple crash causes and multiple possibilities to intervene. Adapting the "road traffic system" to humans and not, vice versa, trying to adapt humans to the system was more central in this approach. Johnston et al. (2014) suggests that these different paradigms reflect how a society feels about road crashes and road safety.

Not only the culture of a society is embedded in these paradigms, they also reflect the knowledge present or, perhaps better, the lack of knowledge. Knowledge is acquired from research and crash analyses. They provide a number of ways to detect crash causes (e.g., Shinar 2019). Data collected by the police after a crash is frequently used to assess crash causes. It must, however, be noted that the police task is not really to determine the causes of a crash, but to determine whether and to what extent a traffic offence has been committed (illegal behavior) and who was the guilty or the innocent party in the crash or the (vulnerable) party that is extra protected by law. This information is also used to determine whether behavior was inappropriate and if a person involved could be held liable for the crash consequences. Therefore, it is not surprising that "human error" emerged as a cause in the databases based on police registration of crashes: more than 90% of crashes involved a human error. This approach is sometimes called "a blame the victim-approach," and this view on crashes is a rather dominant and stubborn view (source).

This view on crash causation was reinforced by two in-depth studies from the 1970s, one from the United States and the other from the United Kingdom. Both are much quoted to this day when it comes to causes of crashes. Rumar (1985) presented the results of both studies side by side and they are surprisingly similar (in 94–95% of crashes the human factor is involved, in 28–34% the road is involved, and in 8–12% the vehicle is involved). These findings are surprising, because the two research teams did not use the same definitions and studied crashes in rather different situations. These results seriously contributed to the often heard statement: "almost all crashes are caused by road users, and roads and vehicles play only a minor role."

Present in-depth studies, however, look not only at the events just before and at the time of a crash, they also try to consider the context of a crash and to understand the underlying circumstances. This perspective is rather common when analyzing industrial safety or, for example, causes of shipping and aviation crashes (Davidse 2003). This perspective tries to understand human behavior and, if opportune, human error. Road crashes are not the result of a series of unsafe road user actions but also of gaps in the traffic system. These gaps are also called latent errors (Reason 1990). This also led to the understanding that if a human factor is found as a cause, a solution is not necessarily found in humans, but in the surroundings of humans (Hauer 2020). For example, a head-on collision on a motorway due to fatigue can be prevented by an adequate median.

In addition to knowledge about the causes of road crashes, another dimension is relevant to conclude whether an idea develops into a road safety paradigm: expectations about the possibility of using policy to eliminate or mitigate causes of crashes. Dutch researchers made important contributions to the international discussions on the causes and the prevention of road crashes.

Erik Asmussen, SWOV's first managing director, was one of the first road safety professionals in the Netherlands who considered unsafe traffic conditions not to be only a problem of the individual road user, but as a problem of the road traffic system. Asmussen (1983) and a scientific working group of the OECD (1984) he chaired built on the previous work of William Haddon. Haddon, the first director of the American National Highway Traffic Safety Administration, introduced a public health model within road safety. This model is known as the Haddon matrix (see, for example, Haddon Jr. 1972).

This matrix contains two axes: one axis for the crash process (pre-crash, crash, and post-crash), and the other axis for the components of road traffic: humans, vehicles, and roads. The matrix consists of three times three cells, and in each cell, road safety problems and/or solutions to those problems can be identified. The great value of the Haddon matrix is that it describes the entire playing field of road safety and not just the field (humans) in which until then problems and solutions were described: the cell "pre-crash – humans."

Asmussen spoke of a dynamic system approach (he used "the phase model" describing how transport and traffic processes, which can result in crashes, and the crash process are regarded as a chronological – the dynamic aspect – complex of successive, increasingly critical combinations of circumstances and events) which he considered to be a tool to structure the road safety phenomenon. In his approach, Asmussen also discarded the idea that crashes have just one cause or solution: road crashes are the result of a combination of factors. If these factors reach a decisive point, a crash will occur. SWOV had already acquired this insight in the 1970s.

Another SWOV researcher, Matthijs Koornstra, the second SWOV managing director, also discarded the idea that road crashes were mainly caused by crash-prone road users. In an analysis, Koornstra (1978) showed that there are no crash-prone road users, but that one may refer to unlucky persons.

This evolution of road safety paradigms discussed in this paragraph is important to understanding the considerations regarding the Safe System approach; after all, the Safe System approach can be seen as the last in a series of paradigms until now. In addition to Matthijs Koornstra, Fred Wegman, SWOV's third managing director, also played a role in the development of the Safe System approach together with Letty Aarts, and more specifically in this new paradigm being further elaborated and accepted as a basis for road safety policy in the Netherlands.

Peter van der Knaap, the managing director since 2013-2021, set out to revitalize the by then 25-years-old approach. Building upon the evident successes and good benefit-cost ratios, together with Letty Aarts, he put special emphasis on the notion of "system responsibility" and the need for continuous policy-oriented learning, including the use of new data (see also Van der Knaap 2017).

This evolution in paradigms, or paradigm shifts, is important to understand the paradigm shift towards the most recent one: Safe System approach.

## Start of the Dutch Safe System Approach: Sustainable Safety. National Road Safety Outlook for 1990–2010

As explained before, several good reasons emerged in the late 1980s to develop a new road safety strategy for the Netherlands based on a new paradigm. First of all, there was a strong ambition to further reduce the number of road fatalities, as expressed in road safety targets: minus 25% fatalities in 2000 (compared with 1985) and minus 50% fatalities resp. minus 40% hospitalizations in 2010 (compared with 1986). Secondly, the downward trend was not that impressive anymore and it was concluded that the 2000-target could not be reached by simply extrapolating trends. Thirdly, it was not expected that the then current set of additional measures and interventions would be sufficient to reach road safety targets. And last but not least, Dutch road safety professionals, more specifically the research community, supported the view that we could not rely anymore on the dominant view at the time: "to blame the road user for a crash and to carry out further training and education to reduce road risks."

The road safety research community developed a new road safety vision for the Netherlands under the leadership of SWOV-researchers (Koornstra et al. 1992). This report is also called "the Purple book." Two elements in this attempt were critical. The research community agreed on a new vision. Secondly, close contacts were established with road safety policy makers and practitioners in order to have them on-board while developing the new vision. As a consequence, we could observe positive responses to this new initiative: a willingness among policymakers to work with the results of this work and the work was welcomed by politicians, by the professional community, by representatives of all tiers of government, and by interest groups.

The choice was made to name the new vision *Sustainable Safety*. This was not the first name to be considered. Initially two working names featured: “inherently safe” and “intrinsically safe.” These “safety by design” approaches (avoiding hazards instead of controlling them) were seen as appropriate for road traffic as well. However, these terms were considered as too technocratic to be sufficiently appealing for this paradigm shift. Several Dutch politicians whispered Sustainable Safety in our ears as a strong brand name for this new approach. This was at the time that “sustainability” was a notion for the forefront of the environmental movement only!

The objective of Sustainable Safety is to prevent road crashes from happening, and where this is not feasible (yet), to reduce the incidence of (serious) injury whenever possible. This can be achieved by a proactive approach in which human characteristics are used as the starting point: a user-centric system approach. This approach refers on the one hand to human physical vulnerability to forces in crashes and on the other hand to human (cognitive) capacities and limitations.

The most important features of sustainably safe traffic are that gaps in the road transport system that result in human errors or traffic violations are prevented (as far as possible) and that road safety depends as little as possible on individual road user decisions. The responsibility for safe road use should not be placed solely on the shoulders of road users, but also on those of who are responsible for the design and operation of the various components of road traffic (infrastructure, vehicles, legislation/regulation). This means that a Sustainable Safe road traffic has an infrastructure that is adapted to the human limitations, vehicles that are designed to support road user tasks and to protect the human body in a crash, and road users that are adequately trained, informed, and when needed, controlled.

Three guiding principles were developed in “the Purple book” of 1991:

- Functionality of roads: monofunctionality of roads as through roads, distributor roads or access roads in a hierarchically structured road network and prevention of unintended road use.
- Homogeneity: equity in speed, direction, and mass at medium and high speeds in order to reduce levels of kinetic energy under tolerable levels for the human body.
- Predictability: predictability of the road course and road user behavior by recognizable road design using consistency and continuity as a design approach.

In order to prevent serious crashes on the road, the three guiding principles were operationalized into a set of practical principles which were used to design measures to be implemented. Large-scale implementation of these measures were realized through the Start-up Programme of Sustainable Safety (Ministerie van Verkeer en Waterstaat 1997).

It was evident that this new approach required a top-down approach to influence decisions of autonomous stakeholders, and a massive investment was envisaged, mainly in the road infrastructure. To illustrate this, we can use the predictability principle: if different road authorities treat similar design issues differently, road users cannot predict from the road layout what to expect on the road’s course. The idea behind the predictability principle is that road users are not aware of any difference between road authorities. Because hundreds of autonomous road authorities in the Netherlands design and maintain the road infrastructure, guidance must be given to road authorities as a binding legal instrument is not appropriate. Another approach was therefore chosen. It was decided to revisit all Dutch design manuals (with the exception of the manual for Dutch motorways) and, based on Sustainable Safety a couple of new design manuals for regional flow roads, for distributor roads and for access roads were developed (and published in Dutch by Knowledge Platform CROW in 2013). And Dutch road designers were found to use their design manuals!

The Dutch national government expressed a clear ambition to bring the Sustainable Safety ideas to implementation. Because the vision relied heavily on a better planned and designed road infrastructure, mainly for municipalities and provinces, the national government built a strong coalition with all road authorities. Furthermore, the national government was willing to co-fund investments to make existing roads and streets meet Sustainable Safety principles. Initial estimates indicated that a full treatment of the whole road network would cost dozens of billions of euro's, and this frightening perspective resulted in attempts to develop "low cost solutions." But it was not fully clear whether these low-cost solutions would be effective enough. Because of this, a three-step approach was designed: demonstration projects (for learning by doing), a Start-up Programme (the first couple of years of implementation, co-sponsored by the National Government), and a final phase of an integral and complete implementation (Ministerie van Verkeer en Waterstaat 1997).

After a couple of successful demonstration projects had been implemented, in 1997 an agreement for a so-called Start-up Programme Sustainable Safety was signed by the Association of Netherlands Municipalities, the Association of Waterboards, the Association of the Provinces of the Netherlands and the Ministry of Transport, representing all tiers of government and all road authorities. The agreement contained 24 measures and actions. The national government made a financial subsidy available and other governments were expected to supplement the subsidy with at least an equal amount. The Start-up Programme also contained an outline of intentions concerning the decision-making process required for the second phase, a full-scale implementation of Sustainable Safety. However, this second phase did never get off the ground, due to reasons that are not related to road safety as such. It was decided to fundamentally change the relationship between the national government and provinces and municipalities resulting in decentralization of policymaking and implementation.

Many actions in the Start-up Programme were aimed at improving road infrastructure, more specifically at a functional categorization of the whole road network (functionality principle), guidelines on road type dependent road markings and the construction of 30 and 60 km/h zones. Furthermore, actions were taken related to enforcement, public campaigns, education, and vehicle safety (for an overview, see Weijermars and van Schagen 2009). Quite some attention in the Start-up Programme was spent on sharing information with road safety professionals. For example, an information point was established. This information point turned out to be a key-feature in supporting practitioners and was highly appreciated by them.

**Table 1** Distribution of road length of 30 km/h and 60 km/h in 1998, 2003, and 2008 (SWOV 2009)

| | 1998 | 2003 | 2008 |
|---|---|---|---|
| **Urban area** | | | |
| 30 km/h | 8.900 (15%) | 29.000 (45%) | 50.300 (70%) |
| 50 km/h | 50.600 (85% | 36.500 (55%) | 21.600 (30%) |
| Total urban | 59.600 (100%) | 66.400 (100%) | 71.900 (100%) |
| **Rural area** | | | |
| 60 km/h | 2100 (3%) | +/− 10.000 (15–20%) | 35.400 (57%) |
| 80 km/h | 63.300 (97%) | 54.000 (80–85%) | 25.500 (43%) |
| Total rural (excl. motorways) | 65.400 (100%) | 64.000 (100%) | 62.100 (100%) |

An example to illustrate the implementation process: during the period 1998–2002, which was extended in the years thereafter, nearly all road authorities drew up a categorization plan in which all roads and streets were functionally classified (first principle). Taking this as a starting point, it is estimated that more than 41,000 km of 30 km/h-roads and more than 33,000 of 60 km/h-roads were constructed (Weijermars and van Schagen 2009). See Table 1 for more details. Initially these streets and roads had a speed limit of 50 km/h or 80 km/h. This included not only a change in speed limit but also a redesign according to Sustainable Safety design principles. In other words, in 10 years time, a dramatic change in urban roads in Dutch cities and (secondary) rural roads took place. Traffic calming, not only urban but also rural, began to be the rule and not the exception in the Netherlands. A questionnaire study among road authorities (Doumen and Weijermars 2009) showed more about the quality aspects of implementing Sustainable Safety. The main conclusion was that a substantial amount of the redesigned roads met Sustainable Safety guidelines to a large extent, although further improvements were recommended to benefit fully from this approach to reduce the number of (serious) crashes.

Weijermars and Van Schagen (2009) assessed safety effects of individual measures and they also estimated combined effects (see also Weijermars and Wegman 2011). They compared actual developments on road fatalities (using police statistics) making use of an extrapolation scenario based on developments 1988–1997. The fatality rate (fatalities per kilometers travelled) dropped 5.3% per year between 1998 and 2007 compared to 1.8% in the 10 preceding years. Based on these earlier developments, fatality numbers in 2007 were about one-third lower than expected. A cost-benefit analysis revealed that the benefits were almost four times higher and all individual measures showed a benefit-cost ratio higher than one. Based on a comprehensive overview of the implemented interventions, the researchers made it plausible, that the fatality reduction was due to interventions that were derived from or inspired by Sustainable Safety.

It is worthwhile to notice that the set-up of the funding scheme for infrastructure, €200 million from the central government for a 4-years period, and raising the same amount from the other road authorities, worked excellently. A case study for the year

2007 (Wijnen and Stroeker 2009) revealed that on Sustainable Safe infrastructure €350 million (mean value per year) has been invested. Substantial amounts of money were also spent on safer vehicles and on police enforcement, and more limited amounts of money on public information, on education, and on research, advice, and policy. The estimate of infrastructure investments for a 10 years period (1998–2007) is 10 times €350 million, 3.5 billion euros. It is important to observe that these budgets were not "road safety earmarked" budgets, but regular budgets for road investments.

The main conclusion of the evaluation of its implementation was that Sustainable Safety was a great success: it resulted in a substantial reduction in the number of fatalities, considerable improvement of a major part of the Dutch road network, and in positive effects of increased and improved enforcement. For example, automated speed enforcement and enforcement on red light violations increased with more than a factor of three between 2001 and 2007 and violations went down most probably. Vehicle improvements also contributed to the success (SWOV 2009).

It is important to observe that interventions and measures were never targeted at the public as components of a road safety vision, but regular consultations took place with communities on interventions and measures. We limited the discussion on the vision Sustainable Safety to decision makers and road safety professionals. The interventions and measures, derived from and/or inspired by Sustainable Safety, were presented and discussed without generally disclosing the wider perspective of Sustainable Safety.

We learned a lot from the implementation of interventions and measures, and it is fair to say that several question marks arose. One example is the so-called "grey roads." The functionality principle proposes to give a road or street only one function to: access, distributor, or through function. However, sometimes it turned out to be inevitable to combine the access function and the distributor function. How to design for this combination, the "grey roads"? Another issue that arose: Sustainable Safety relied heavily on improving road infrastructure, but how about using modern (vehicle)technology instead of costly infrastructure investments? Could it be preferable to wait for new technologies?

Year after year the Start-up Programme was extended beyond the intended period 1997–2000 and as a consequence, the more fundamental decision what to do in the future was postponed. At that time, a couple of important developments occurred in Dutch public administration which led to issues far bigger than road safety. The national government decided to decentralize the implementation of policies to other tiers of government, such as provinces and municipalities. Furthermore, the Dutch government decided to move some tasks to civil society organizations and to the private sector. This was a major reform in Dutch society. In this process, the Dutch national government also delegated road safety tasks to other parties, but it became obvious that those who were supposed to take over these tasks were not yet prepared and equipped to do so. Hence, a period of uncertainty and ambiguity about the implementation of road safety policies began. This period (the late 1990s) is characterized by a high level of ambition (ambitious road safety targets) and no clear ideas of how to realize the ambitions. In the first decade of the new millennium, it was therefore time to draft a second edition of Sustainable Safety trying to respond to these challenges and to new opportunities.

## Advancing Sustainable Safety: National Road Safety Outlook for 2005–2020

Because unfortunately the Start-up Programme Sustainable Safety was not followed by a second phase, several new initiatives were developed. A collection of essays by experts was published in *Denkend over Duurzaam Veilig* (Thinking about Sustainable Safety) (Wegman and Aarts 2005). The Foreword title of this collection of essays, "Inspiration, commitment and synergy," reflected the spirit of that time. Sustainable Safety was considered to be a sound basis for future policy development on road safety and all authors of the book were in support of this. It was inspiring to learn about the many excellent recommendations, either based on the implementation so far, or anticipating on new opportunities, or just presenting creative new initiatives.

In the same year, a new "Purple book" titled *Door met Duurzaam Veilig* (Wegman and Aarts 2005) was published as the follow-up to *Naar een duurzaam veilig wegverkeer* (Towards Sustainable Road Traffic Safety) (Koornstra et al. 1992); the English translation *Advancing Sustainable Safety* was published in 2006. In this advanced edition, adaptations were made where necessary, based on what we had learned from our first steps towards a sustainably safe road traffic. The Sustainable Safety vision was also updated in accordance with new insights and developments. We chose a broader perspective for this book than we did in 1992. This broader perspective is justified, because we had been able to evaluate the results of our efforts to date. Moreover, there was high demand from practitioners to develop Sustainable Safety for specific problem areas or problem groups. Furthermore, the institutional settings for implementing governmental policies in the Netherlands, also for road safety, changed drastically (Wegman et al. 2008). Finally, this perspective offered the opportunity to "position" the vision again, to eliminate any misunderstandings and to create a new momentum for effective implementation.

The Dutch version of the second "Purple book" was presented to the Dutch Minister of Transport at the time, Mrs. Karla Peijs, and was welcomed by her. It is of crucial importance to notice that this book did not just address the Minister of Transport but also addressed representatives of institutions such as municipalities, provinces, water boards (road authorities in the western part of the Netherlands with an important road authority task), judicial authorities, police, car industry, etc.

We identified the following key approaches for this second edition (see also Wegman 2010):

- An ethical approach: we do not want to hand over a road traffic system to the next generation with the current casualty levels, but considerably lower ones.
- A proactive approach: we do not need to wait for crashes to occur before taking action, because we have a stock of knowledge that can be used.

- An integral approach: integrate man, vehicle, and road into one safe system; cover the whole network, all vehicles and all road users, and integrate with other policy areas.
- Man is the measure of all things: human capacities and limitations are the guiding factors together with the vulnerability of the human body in road crashes.
- Reduction of latent errors (system gaps) in the system: in preventing a crash we will not fully be dependent on whether or not a road user makes a mistake, commits an error or violation.
- Use criterion of preventable injuries: if we know the cause of a crash, if we know the cure, and if the cure is cost-beneficial for society.

As we illustrated earlier, a crash is rarely caused by one single unsafe action; it is usually preceded by a whole chain of poorly attuned occurrences. This means that it is not only one or a series of unsafe road user actions that cause a crash; also gaps in the traffic system contribute to the fact that unsafe road user actions can result in a crash. These gaps are also called latent errors (Reason 1990). It is also known as the Swiss cheese model of accident causation. The holes in the slices (of Swiss cheese) represent weaknesses. In summary: crashes occur when latent errors in the traffic system and unsafe actions during traffic participation coincide in a sequence of time and place (Fig. 1).

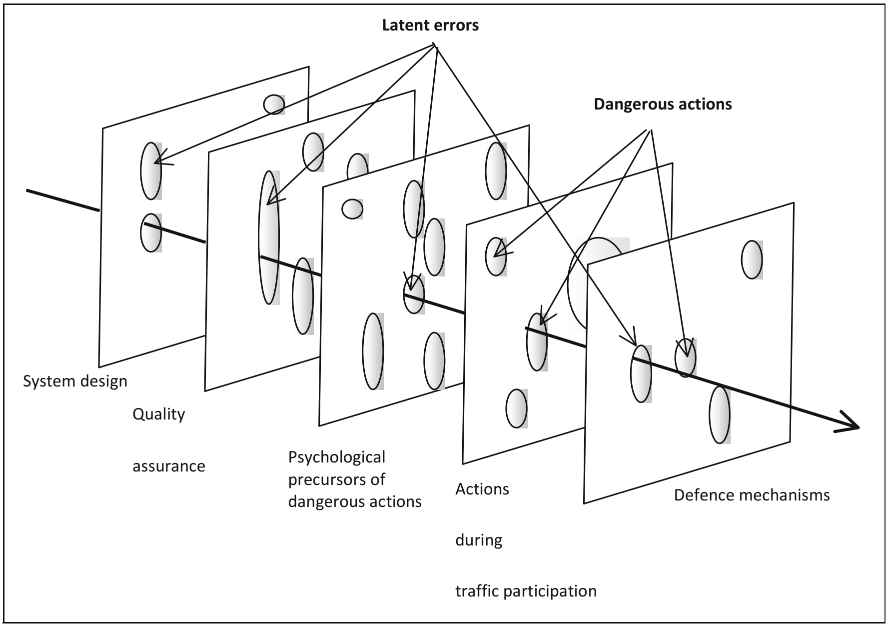


**Fig. 1** Diagram showing the development of a crash (bold arrow) as a result of latent errors and unsafe actions in the different elements composing road traffic (based on Reason 1990). If the arrow encounters “resistance” at any moment, no crash will develop

As unsafe actions can never entirely be prevented, the Sustainable Safety vision aims at banishing the latent errors from traffic: the road traffic system must be *forgiving* with respect to unsafe actions by road users, so that these unsafe actions cannot result in crashes. The sustainable character of measures mainly lies in the fact that actions during traffic participation are made less dependent on momentary and individual choices. Such choices may be less than optimal and can therefore be risk-increasing.

Adjusting the environment to the abilities and limitations of the human being is derived from cognitive ergonomics, which in the early 1980s made its entry coming from aviation and the processing industry. In all types of transport other than road traffic, this approach has already resulted in a widespread safety culture. Further incorporation of the Sustainable Safety vision should eventually lead to road traffic that can be considered as "inherently safe" as the result of such an approach.

The fundamentals remained the same in the second edition of Sustainable Safety. The objective of Sustainable Safety was and remained to prevent road crashes from happening, and, where this is not feasible, to reduce the incidence of (serious) injuries whenever possible. This can be achieved by a proactive approach in which human characteristics are used as the starting point: a user-centric system approach. On the one hand, these characteristics refer to human physical vulnerability, and to human (cognitive) capacities and limitations on the other.

The principles of the first edition (functionality, homogeneity, and predictability) were reformulated where appropriate, and two new principle were added. This resulted in five principles:

- Functionality of roads.
- Homogeneity.
- Forgivingness (of the environment and other road users).
- Predictability (of the road course and road user behavior by recognizable road design).
- State awareness by the road user.

The forgivingness principle makes it possible to pay explicit attention to road side design and to the interaction between different types of road users. This "new principle" was in fact already embedded in the first edition of Sustainable Safety, but it is appropriate to position it explicitly.

The predictability principle, also already in the first edition, deals with a road environment and road user behavior which support road user expectations through consistency and continuity in road design. A road is self-explaining (Theeuwes and Godthelp 1993) if the design itself is made enough standardized and predictable. One of the main issues is to reduce speed variance between drivers, and also to minimize speed adaptation to prevailing conditions.

The state awareness principle is derived from the task-capability model as developed by Ray Fuller (Fuller 2005). In his model, Fuller compares road user task demands or task difficulty with the task capability to perform a task safely. Task capabilities is a combination of the competences of a road user minus the situation dependent state (for example, influenced by fatigue, distraction, impairment). Driving speed is the most distinctive factor in relation to decreasing or increasing task difficulty. The state awareness principle makes eliminating distraction, drinking and driving, fatigue, etc. explicit components of the Sustainable Safety approach.

The Dutch vision Advancing Sustainable Safety as presented by Wegman and Aarts (2005, 2006) has been translated in numerous ideas for practical proposals concerning road infrastructure, vehicles, intelligent transport systems, education, regulations and their enforcement, speed management, drink and drug driving, young and novice drivers, cyclists and pedestrians, motorized two-wheelers, and heavy goods vehicles.

The final part of the publication (Wegman and Aarts 2005, 2006) pays attention to various components of implementation. We learned a lot during the introduction of Sustainable Safety, and the new thoughts on organization of policy implementation, on quality assurance, on funding, and on accompanying policy are discussed in this part of the handbook.

The authors of the second edition acknowledged that, unlike the first edition, Sustainable Safety could no longer be regarded as the basis for a national road safety plan to be implemented. The environment changed with more decentralized responsibilities, with many different and more or less autonomous stakeholders and without a strong top-down push from the national government. Sustainable Safety was expected to flourish more when used as a guiding concept for a multi-stakeholder setting. This different view on implementation did not really come about because the designers of Sustainable Safety expected better results. This was due to the fact that policy making and implementation, also in the field of road safety, changed because the Dutch public administration changed.

Decentralization became en vogue in the Netherlands some 20 years ago. Basically, this reform refers to the transfer of powers and responsibilities from the central government to elected authorities at a subnational level. The consequences for Sustainable Safety were huge. It resulted in an increase in mutual dependence between parties in the implementation context and it was necessary to base the implementation of the next phase of Sustainable Safety on the perspective of implementation as a coordination process in a multi-stakeholder environment, as presented in Table 2.

This new perspective became a very serious hurdle for road safety improvement and further implementation of Sustainable Safety. Decentralization is a major reform in many countries, such as the Netherlands, and certainly not a panacea for all problems in society. An OECD-report (OECD 2019) developed 10 guidelines for a successful implementation of decentralization, some of which were not met when decentralizing the implementation of road safety in the Netherlands. To name a few: no adequate subnational capacity building, insufficient funding for various road safety responsibilities, and no adequate coordination mechanisms across levels of government.

The next phase of Sustainable Safety did not come into being. A strong and leading Road Safety Agency was missing and moreover, at a regional and local level road safety professionals, who were familiar with Sustainable Safety, left because of

**Table 2** Two visions on the implementation of Sustainable Safety

| Implementation as rational programming | Implementation as co-ordination process in a multi-stakeholder setting |
|---|---|
| Sustainable safety is an effective concept that has to be implemented as completely and uniformly as possible. | Sustainable safety is not static. It is about realizing uniformity and an adequate adaptation in dialogue with executive organizations. |
| Central control is the best guarantee for a complete and uniform implementation. | Central control leads to adaptation problems and alienates potential partners, whereas central administration failed as an ally in the past. |
| Area-orientated policy and faceted policy are detrimental to uniform and complete implementation. | Area-orientated policy and faceted policy offer opportunities for adaptation of sustainable safety at decentralized level and proactive involvement of related policy areas. |
| Success is the extent to which the realized measures comply with the ideals of sustainable safety. | Success is comprised of road safety benefits relative to existing situations. |
| Research institutes contribute to the content of sustainable safety based on their scientific knowledge. | Knowledge about sustainable safety facilitates decentralized administrations and other actors in the preparation of measures with road safety impacts. |

budget reductions or because of (early) retirement. The assumption behind decentralization (more effective and efficient policies and implementation) failed to be true for road safety. Unfortunately, from a perspective of road safety, it is unavoidable and sad to conclude that Sustainable safety was not strong enough to survive in a climate of reduced political interest in road safety starting at the end of the first decade of the twenty-first century; there was no longer a decent "road safety plan." Some people concluded that Sustainable Safety became a weary vision and something new was needed.

## Sustainable Safety the Third Edition: The Advanced Vision for 2018–2030

In 2013 and 2014, the annual amount of road deaths in the Netherlands reached its lowest number since decades, and for the seriously injured, this point was reached in 2016. The years thereafter, however, the number of casualties increased. Furthermore, discussions were emerging about "who is responsible" for societal results such as safety. The question was raised whether people could be made more responsible for their contribution to societal needs, and this was illustrated in several examples such as citizens contributing to better neighborhoods. It was, however, maybe too easy to put this idea further towards other domains such as road safety where the most recent insights were not to put the responsibility for crashes on the road user, but far more on the designers and operators of the road transport system This was also a general approach that got international support from road safety experts (ITF/OECD 2016). This development, together with the observation that still a number of effective measures were not yet implemented, provided the breeding ground for Sustainable Safety third edition.

The third edition of Sustainable Safety (SWOV 2018) builds upon the success of the earlier Sustainable Safety philosophy (Koornstra et al. 1992; Wegman and Aarts 2006) but aligns itself to several developments, such as the change in demography, increasing urbanization, and technological developments. In addition, ways were explored to "revitalize" the vision also inspired by discussions on the role of government, the role of citizens, civil society, and the private sector when it comes to relevant themes for society, like road safety.

International elaborations of what is considered as a "Safe System approach" (OECD/ITF 2008, 2016) also provided inspiration for the third edition of Sustainable Safety, for example, the concept of "responsibility." The third edition of Sustainable Safety makes use of new opportunities and recommends completion of several effective, yet unfinished measures with the ultimate aim to move towards a casualty-free traffic system. At a national level, the third edition of Sustainable Safety provided a substantiated framework for further development of the national road safety policy of the Netherlands as written down in the new Strategic Road Safety Plan (Ministry of Infrastructure and Water Management et al. 2018).

In brief, the following elements of the third edition can be highlighted:

- More focus on new and still frequently occurring serious crashes in the Netherlands, such as bicycle crashes without involvement of motorized traffic.
- A more explicit vision on what to accept in road traffic, what needs to be mitigated, and what needs to be eliminated.
- The road safety principles are more often linked to more than one type of measure (e.g., infrastructural measures and vehicle measures). They provide the opportunity to achieve similar results through a combination of complementary measures.
- The road safety principles are expanded and divided into three design principles and two organization principles.
- A more explicit emphasis on the specific responsibilities of different road safety stakeholders in realizing a sustainably safe road traffic system. Traffic professionals are crucial in this respect, even if the problem is the behavior of road users. Responsibilities are made more explicit in one of the organization principles, "effectively allocating responsibility," and in this respect links more clearly with the international vision of an inherently safe traffic approach.
- In order to better assist traffic professionals in making the traffic system structurally safer, not only are data on common crash types and casualties used as the basis of policy but also the use of surrogate safety measures in traffic (risk factors or road safety performance indicators, SPIs in short). The most important risk factors can serve as significant intermediate goals and offer deeper understanding of the underlying problems. These risk factors are necessary for assigning roles and responsibilities to the various road safety stakeholders.

In the revised Sustainable Safety vision, the ideal for the future is to make road use as inherently safe as possible by taking into account the demands and possibilities of road users now and in the future. The vision acknowledges the mobility demands of various groups in our society, the importance of satisfactory accessibility by road, and the need for a personal freedom of choice. It is a fact that certain modes of transport are inherently less safe (i.e., two-wheeled vehicles) and certain road users are more prone to traffic injury than others (e.g., children, teenagers, elderly). With these facts as a starting point, Sustainable Safety's third edition aims at maximum safety for all, that is: as safe as possible.

To reach maximum safety, a Safe System approach builds on the following implementation stages, in accordance with the societal context:

- Elimination: ideally, dangerous situations are made physically impossible so that people do not find themselves in such situations.
- Minimization: the number of dangerous situations is limited, and certain modes of road transport are made unattractive to limit people's exposure to risks.
- Mitigation: where people are exposed to risks, their consequences should as far as possible be mitigated by taking appropriate mitigating measures.

The third edition of Sustainable Safety emphasizes that "the human dimension" is not only relevant in relation with human beings as road users but also in relation with the professionals who design, implement, and/or manage elements of the traffic system (roads, vehicles, information, control systems, etc.). The same human characteristics that apply when they are road users are also more or less valid when they act in a professional capacity. This implies that in the further development and maintenance of a Sustainable Safe system, it is necessary for the professionals to organize all the processes involved to take maximum account of the human dimension.

The elements of Sustainable Safety complement and reinforce one another, making it as fail-safe as possible. If one element in the system fails, it is to be substituted or compensated for by other elements. This applies for unsafe situations – such as temporary malfunctions – as well as for human behavior. It applies to the process of traffic participation as well as to the work processes of traffic professionals.

### Road Safety Principles of the Third Edition

In the third edition of Sustainable Safety, five principles are essential: three design principles (1, 2, and 3) and two organization principles (4 and 5).

- Functionality of roads.
- (Bio)mechanics: Limiting differences in speed, direction, mass, and size, and giving road users appropriate protection
- Psychologics: Aligning the design of the road traffic environment with road user competencies.
- Effectively allocating responsibility.
- Learning and innovating in the traffic system.

The functionality of roads remains a solid basis for the vision, although the third edition pays attention to the earlier mentioned criticisms on, for instance, roads that do not fit well in a monofunctional approach (the so-called “grey roads”). Solutions are found in the concept of “safe speed” in case monofunctionality cannot be met.

The second design principle – (bio)mechanics – is a combination of the old principles of homogeneity (edition 1 and 2), physical forgivingness (edition 2), and new elements added that specifically apply to the safety of two-wheeled vehicles, especially bicycles. This last issue turned out to be a large and growing problem in road safety in the Netherlands. We discovered this by linking police data and hospital data to get a complete picture of “serious injuries” (SWOV 2019). According to the (bio)mechanics principle, ideally, traffic flows and transport modes ideally are compatible with respect to speed, direction, mass, size, and degree of protection. This is supported by the road design, the road environment, the vehicle, and, where necessary, additional protective devices. For two-wheeled vehicles, it is important that the road and the road environment contribute to the stability of the rider. Besides paying attention to the huge problem of single bicycle crashes in the Netherlands, this second design principle applies to infrastructure, speed, vehicle design, and protective devices.

The third and last design principle incorporates the old principle of predictability (edition 1 and 2) and state awareness (edition 2), and adds to it a number of other psychological issues which have turned out to be relevant for safe road user behavior. The principle of psychologics states that the design of the traffic system should be well-aligned with the general competencies and expectations of road users, particularly the elderly. This means that for them as well as others, the information provided by the traffic system is perceivable, understandable (“self-explaining”), credible, relevant, and feasible.

Nevertheless, road users should be capable to carry out their traffic task and should be able to adjust their behavior according to the task demands for safely participating in traffic under the prevailing circumstances. This applies for drivers (skilled and fit for the driving task) as well as for nonmotorized road users (skilled in dealing with traffic and fit to participate in traffic).

New in the third edition are principles for the organization of a Safe System. It starts with the principle of responsibility and states that this is allocated and institutionally embedded in such a way that it guarantees a maximum road safety result for each road user and optimally integrates with the inherent roles and motives of the parties involved. In principle, road users follow the rules and set a good example for children and teenagers. Thanks to a forgiving traffic system, road users will not be punished for their errors and weaknesses with crashes and serious injuries.

As the world changes continuously, this requires that a safe traffic system and the professionals who design, implement, and maintain the system to adequately adapt to these changes. Therefore, the last organizational principle of the third sustainable safety vision is about learning and innovating the traffic system. The Deming cycle is relevant here: it starts with the development of effective and preventive system innovations based on knowledge of causes of crashes and hazards (Plan). By implementing these innovations (Do), by monitoring their effectiveness (Check), and by making the necessary adjustments (Act), system innovation ultimately results in fewer crashes and casualties.

In order to design countermeasures that are feasible and practical, it is important to further operationalize principles into "Requirements for a Sustainably Safe Road Traffic System." In addition, it is also important to draw up a Sustainable Safety Knowledge and Research Agenda that will strengthen further development of Sustainable Safety.

A number of measures that fit in a Sustainable Safety are illustrated below.

Illustration 1: Exposure of vulnerable road users to motorized traffic where vulnerable road users share road space with motorized traffic, the road clearly has an exchange function (functionality principle). From the principle of (bio)mechanics, major differences in speed should be avoided. In order to prevent crashes with serious injuries, it is important that motorized traffic is limited to a maximum speed of 30 km/h. This can be realized by adapting road design, vehicle, information provision, and enforcement to these traffic conditions and to the needs of the prevailing road users' groups

Aim: Maximum speed of 30 km/h at locations where there is interaction between vulnerable road users and motorized traffic. Types of solution ranging from full freedom of choice, just informing to safety by design in relation to speeding behavior (and thus an increased level of Sustainable Safety):

- Mandatory open ISA (Intelligent Speed Adaptation) and fines: continuously inform motorized road users about the legal speed limit and fine them when they drive too fast.
- Credible road design: physically nudge motorized road users to maintain a maximum speed of 30 km/h by providing a road layout that is appropriate for no more than this speed. This can be achieved by limiting the length of tangents (straight road sections), by providing physical speed reduction measures (e.g., speed humps or raised junctions), a narrow cross-sectional profile, an uneven road surface, or by placing buildings or vegetation close to the road.
- Mandatory closed intelligent speed adaption: eliminate high speeds by limiting the speed of all motorized traffic to 30 km/h.

Illustration 2: Single-bicycle crashes. Cyclists form a significant proportion of the seriously injured traffic casualties, many of them being seriously injured in a single-vehicle (bicycle) crash. The bicycle infrastructure plays an important role in these single-bicycle crashes. In particular, obstacles (lack of forgivingness) and balance-disrupting road elements (combined in the principle of (bio)mechanics) are sources of concern. To substantially reduce hazardous situations on the cycling infrastructure, special attention should be given to these crashes in the future

Aim: Cyclists do not fall, do not hit obstacles, and are physically protected in case something goes wrong. Types of solution within the traffic system and for the road user, again with an increasing amount of safety by design (less opportunity for unsafe choices) and thus an increasing level of Sustainable Safety:

- Physical protection of the cyclist: as long as the road infrastructure and the road environment do not offer sufficient protection against injuries in the event of a crash, protective cycling gear provides some level of protection to the cyclist.
- Obstacle-free, spacious, and skid-resistant bicycle infrastructure: create a bicycle infrastructure that is forgiving and therefore free from slippery substances (loose sand/gravel/leaves), obstacles, and vertical edges and ridges that can cause cyclists to lose their balance, fall, and injure themselves. Additionally, create a bicycle infrastructure that is wide enough to provide cyclists with the space for natural lateral movement and is sufficiently skid-resistant to prevent cyclists from skidding in bends.

Illustration 3: Distracted motor vehicle drivers, distraction among drivers, for instance, because of the use of the smartphone, contributes to a 3–4.5 times' higher crash risk compared to normal, undistracted driving. Causes and solutions are mainly found in the Sustainable Safety third edition principle of psychologics

Aim: Distraction of motorized vehicle drivers does not result in serious casualties. Types of solution with a decreasing amount of chances to make unsafe choices and consequently an increasing level of Sustainable Safety:

- Warning system: the car warns the driver against unsafe situations and gives priority to the most important information to prevent the driver from being overloaded with information.
- Restricting use of electronic devices: electronic non-traffic devices are automatically switched to a safe mode which prevents the driver from using them while behind the wheel. Other vehicle occupants can still use their devices.
- Autonomous (self-driving) vehicles: the vehicle undertakes the driving task without interference from occupants. The vehicle and related technology is programmed to safely deal with all types of traffic interactions. Vehicle occupants can engage in non-driving tasks, for example, reading a newspaper, operating a laptop, phoning, or participating in a meeting. The large-scale introduction of autonomous vehicles is not expected until 2030, but preparations for a safe operating system and the transition towards it are ongoing.

As we showed in this chapter, the third edition of Sustainable Safety builds on previously developed and shared principles, requirements, and measures. A primary recommendation is therefore also to complete what has proven to be effective. Past Sustainable Safety measures have had great success despite not being fully implemented. Examples of measures that should be finalized to have even more effect are the full implementation of credible road layouts, sufficient separation of high-speed traffic (especially with vulnerable road users), and evidence-based education.

The third edition of the vision also provides a framework for elaboration, operational requirements, and measures that may be developed in the future or that already exist but cannot as yet be applied to accomplishing a sustainably safe road traffic. For example, policy makers may consider vehicle safety and protective measures, road and vehicle technology, responsibility of professionals and the role of education, regulation and enforcement for road safety professionals, as well as for road users. In other words: the Sustainable Safety vision incorporates and provides a framework for effectively dealing with new challenges and making effective use of new technologies.

The updated vision also looks back at the results that have already been achieved – fully or only partially. For instance, effective interventions focussed on the prevention of serious road injuries were insufficiently incorporated in the previous editions of Sustainable Safety. Also, further road safety improvements for vulnerable road users deserves more attention from the perspective of current insights. The problems encountered in the past stemming from the implementation of minimally designed 30 and 60 km/h zones should no longer impede the realization of maximum road safety. Road safety would also benefit from correcting flaws that stem from failing to sufficiently account for the human dimension as a basis for design and guidelines.

For the further implementation of a sustainably safe traffic system, it is beneficial to collaborate with other organizations and stakeholders. The elaboration of operational requirements clearly calls for collaboration with organizations that are active in the field of regulation, guidelines development, publication, and professional education, but also with interest groups representing groups such as motorists, cyclists, and traffic safety advocates. With respect to implementing measures, road authorities and other traffic professionals have the most important role. They are invited to reflect on how the updated vision may be relevant for their policy and how it may help them in taking new steps.

Current initiatives also offer opportunities in the Netherlands to implement a Sustainable Safe road traffic system. A number of civil society organizations invited the Dutch government to put road safety higher on the political agenda and proposed to make higher budgets available for road safety investments. The insight that investments in road safety measures are likely to be cost-beneficial and can contribute to stimulate economical developments is helpful here. The increasing numbers of people killed and seriously injured in Dutch traffic in recent years is considered as an undeniable signal. The Strategic Road Safety Plan 2030 (Ministerie van Infrastrutuur en Waterstaat et al. 2018) responded to this initiative and includes new directions such as a risk-based, proactive approach (based on the use of Safety Performance Indicators), the chain approach to implementation, and the reflection on the "governance" of road safety policy and ambitions to get to zero (serious and fatal) road casualties. Sustainable Safety's third edition provides a framework to realize the formulated ambitions with maximum safety by adopting the following, most important policy aspects:

- Make clear choices when it concerns the functionality of roads.
- Take vulnerable road users as a basis from the perspective of (bio)mechanics.
- Adjust the traffic system to the competencies of the elderly.
- Further reflect on an effective allocation of responsibilities.

- Perform in-depth research into all fatal crashes and implement a risk-based approach with Safety Performance Indicators as the basis for learning and innovating.

## Epilogue

We conclude this chapter with a couple of thoughts on looking back and looking forward.

### Reflections on 30 Years Sustainable Safety

The Netherlands, along with Sweden, was one of the first countries to implement a Safe System approach. In 1992, the vision on a Sustainable Safety was conceptualized (Koornstra et al. 1992); in 1995, a small number of demonstration projects were launched; and in 1997, this culminated in the adoption of the Start-up Programme Sustainable Safety. The Start-up Programme was a milestone involving the adoption of a formal covenant, signed by all the public road authorities. Even before the formal adoption of the Sustainable Safety vision, and parallel to the Start-up Programme covenant, measures had been taken in the spirit of this vision, such as: building high-quality motorways, providing footpaths for pedestrians and separate bicycle tracks for cyclists. The Start-up Programme not only created a financial incentive for the further roll-out of Sustainable Safety measures, it also facilitated a coordinated approach to redress the growing road safety problems. Since implementation, these measures have proved to be cost-effective and reduced the number of road deaths. This systematic approach set an international example and certainly made a firm contribution to making the Netherlands a top-ranking player in the field of road safety.

In 2005, the second edition of the Sustainable Safety approach was presented with Advancing Sustainable Safety (Wegman and Aarts 2005, 2006). This generated renewed interest in the philosophy, partially attributable to two new principles: forgivingness and state awareness. Road authorities and policymakers continued with the implementation of measures in accordance with the outlines of the Start-up Programme. However, a lack of political priority for road safety, less effective coordination between different stakeholders and reduced resources prevented Sustainable Safety from being completed.

We have unfortunately seen that due to various developments (Weijermars et al. 2013), the number of road deaths has held constant and the number of serious road injuries has been increasing. Evaluation results learned that implementing Sustainable Safety has been very successful in reducing the number of fatalities, but not successful in reducing the number of serious injuries, and more specifically in reducing the number of serious road injuries in crashes not involving motorized vehicles. Almost all of these seriously injured are cyclists (Weijermars et al. 2013). Because speed reduction is a key element of Sustainable Safety, it is not surprising that implementation is more effective in reducing fatalities than in reducing injuries.

However, it is alarming that an increasing trend in single-cycling crashes has been observed. This leads to the important conclusion that the idea of forgiving infrastructure to prevent single-cycling crashes must be added to Sustainable Safety.

The need for a third edition of a Sustainable Safe road traffic (SWOV 2018) coincided with the increase of the number of road casualties. It tries to respond to developments regarding demography, urbanization, and technology, and national as well as international discussions on the organization of and responsibility for societal benefits such as road safety. The third edition gave room to these developments, making the vision "future proof" again, also by adding organizational principles like "effective allocation of responsibilities" and a renewal principle of "learning and innovating." The vision incorporated new insights based on an analysis of road crashes (e.g., single bicycle crashes causing a large number of serious injured) and taking especially the competencies of elderly road users as a reference point. The five principles of the third edition provide the framework for a casualty-free road traffic system the Dutch government is aiming for. At least, they are presented as such. The focus on a risk-based approach and making use of safety performance indicators (SPI's) may help in closing the gap between the vision and the pragmatic approach of a road safety plan. This process is expected to go on the coming years.

## The Future of Sustainable Safety in the Netherlands

The third edition of Sustainable Safety is on its way. It is a matter of a stubborn continuation of effective measures and interventions and trying to reach "100%." Furthermore, it is a matter of trying to use new opportunities, especially those provided by technology: to prevent risky road use (fatigue, distraction, impairment), to support drivers to prevent dangerous behavior (application in enforcement), and to support in prevention of crashes by speed management. Three challenges lie ahead of us:

Challenge 1 – Decentralization: maintaining national standards and road layout uniformity. Since the early 2000s, decentralization has led to more tasks and responsibilities for local governments. One particular risk of decentralization is the loss of a uniform road layout and design.

Challenge 2 – Policy integration: discovering win-win opportunities for integrated policy initiatives while staying focussed on safety. Policy programs that work according to an integrated approach which not just includes road safety objectives but also objectives in, for instance, health, urban, and climate policies may yield substantial benefits. Whether or not these benefits are actually achieved depends on the quality of "connective" agenda setting and cooperation.

Challenge 3 – Wise spending: calculating the optimal cost-benefit ratio of the Safe System approach. Calculating the expected benefits of road safety investments ex ante can empower road authorities and other actors to make better investments in road safety. An even stronger "business case" for Sustainable Safety requires better evidence on the optimal results that (only) a well-designed use of infrastructural, technical, and behavioral measures can yield.

### Sustainable Safety in International Perspective

Sustainable Safety is used in the Netherlands as a name for its Safe System approach. Vision Zero is the name chosen in Sweden and in many other countries. The OECD used Towards Zero (2008) and later "Zero road deaths and serious injuries." These different names do not really reflect major differences in approaches as the core idea how to reach these aims starts from the idea that the system needs to be tuned to the competences of traffic participants. It requires real understanding of the human component and how the system can deal with it safely. Whereas the Netherlands and Sweden were starters in developing a Safe System approach, other countries, regions, and cities have been showing a growing interest in developing their own version of a Safe System approach (OECD 2008, 2016). Four starting points have to be adapted everywhere: (1) people make errors, (2) the human body has a limited physical ability to tolerate crash forces before harm occurs, (3) improving road safety is a shared responsibility, and (4) all parts of the road transport system must be strengthened, and if one part fails users are still protected (OECD 2016). Many policy documents in the world use Safe System or Vision Zero in their name these days; however, the presented measures and interventions are not always really reflecting the genes of Safe System thinking. That is confusing.

Differences in conceptualization of the Safe System approach in practices and tools and in Safe System management between countries can be observed. Speed management is a key principle for Safe System and takes literally a very central role in the Australian approach (safe roads, safe vehicles, safe people, and safe speeds). These differences basically reflect differences in "structure and culture" between countries (see also Koornstra et al. 2002) and perhaps differences in "taste" of policy designers. Further (evaluation) research have to show us how these differences affect road safety.

### Sustainable Safety: Fourth Edition or a Next Paradigm?

The current paradigm in road safety – Sustainable Safety as an example of a Safe System approach – has a solid basis in scientific knowledge and recognizes that the responsibilities to make road traffic truly safe (without serious injuries) is shared between individuals and a wide range of stakeholders. The individual road users remain a critical part. But a key feature of the Safe System approach is not to blame the road user when failing to behave safe. The Haddon matrix (1972) clearly depicts the many areas and fields to improve road safety. And it is a given that many different (autonomous!) stakeholders have responsibilities, not just different tiers of government, but also the private sector and civil society. As long as individual road users make decisions in traffic and the context of these decisions will be shaped by the many stakeholders involved, the Safe System approach will remain a valid and effective approach. Strong leadership and institutional management remain needed.

Of course, Sustainable Safety have to adapt itself to new developments and opportunities in society. From this perspective we conclude that Sustainable Safety 4.0 is sooner to be expected than a paradigm shift. If a game changer like self-driving vehicles ("level 4 or 5 of driving automation") will be a reality, the question will be answered differently, perhaps. If we will ever reach that state in the Netherlands with the many bicycles everywhere, is still questionable. Time will learn.

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# Vision Zero in Germany

# 11

Wolfram Hell, Kurt Bodewig, Ute Hammer, Christian Kellner, Clemens Klinke, Matthias Mück, Martin Schreiner, Felix Walz, and Guido Zielke

## Contents



W. Hell (✉)
Gesellschaft für Medizinische und Technische Biomechanik e.V., gmttb (Society for Medical and Technical Biomechanics), Munich, Germany

Department of Forensic Epidemiology, Ludwig-Maximilians-University of Muenchen; gmttb, Muenchen, Germany

K. Bodewig
Deutsche Verkehrswacht, Berlin, Germany

U. Hammer · C. Kellner
Deutscher Verkehrssicherheitsrat DVR, Bonn, Germany

C. Klinke
Dekra Se, Stuttgart, Germany

M. Mück · M. Schreiner
City of Munich, Munich, Germany

F. Walz
Gesellschaft für Medizinische und Technische Biomechanik e.V., gmttb (Society for Medical and Technical Biomechanics), Munich, Germany

G. Zielke
Federal Ministery for Digital and Transport, Berlin, Germany



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**Abstract**

Vision Zero has a central role in traffic safety in Germany. Finally, it was even a relevant point in the coalition treaty from the Federal Governing Parties in the year 2018.

It is a unifying theme for safety measures taken on the federal, state, and local levels and in private, nonprofit traffic safety organizations. In later years, cooperation between these different agents has been intensified. Evaluation and measurability are essential in the German approach to Vision Zero. One example of this is the statistical work performed every year to identify “zero cities,” i.e., cities that had zero road fatalities the previous year. A yearly award puts focus on cities that have a particularly long string of zero years, in relation to their size. This is performed on an international level, and cities around the world are incentivized by these recognitions. Munich is used as an example of a city that has recently stepped up its traffic safety work. The city has adopted Vision Zero and followed up this with intensified traffic safety work, including improved data collection, the identification of accident black spots, targeted measures to improve safety in these black spots, safety audits of new infrastructure plans, etc. Before the introduction of new traffic technologies which may have an impact on safety, in-depth technology assessment has to be performed. This is illustrated by an example in which sufficient prior technology assessment did not take place, namely the introduction of e-scooters in Germany. After their introduction, they have turned out to be significantly more dangerous than bicycles, as can be seen from the statistics of fatalities and severe injuries. Proposals are made for measures are needed to reverse this trend, including obligatory use of helmets. The dialogue with neighbor states is also essential. Here the Traffic Expert Society of Medical and Technical Biomechanics, gmttb (Germany, Austria, and Switzerland= D A CH), has initiated to discuss and bundle basic principles of the Vision Zero in three neighbor countries. To promote Vision Zero, gmttb also organizes interdisciplinary yearly conferences with experts from Austria (Vision Zero is a state philosophy) and Switzerland (here named Via Sicura) to bundle strength and adopt ideas together with Swedish and multinational experts. As well as a yearly gmttb Vision Zero Safety Award is granted to motivate people, organizations, and manufacturers to promote good ideas for better traffic safety.

**Keywords**

Accident black spot · Driver's education · E-scooter · Electric micro-vehicle · Federal Republic of Germany · Helmet · Munich · Technology assessment · Vision Zero · Zero city

## Adoption and Basic Principles (Christian Kellner, Ute Hammer DVR)

Vision Zero had early supporters in Germany. For instance, the "Traffic Club Germany" (VCD) developed a plan for Vision Zero in 2004, (https://www.vcd.org/themen/verkehrssicherheit/vision-zero/) and the Federal State of North Rhine-Westphalia included Vision Zero in its road safety program in 2005. The idea gained further impetus on the federal level in September 2007 when the executive board of the German Road Safety Council (DVR) resolved to align its road safety activities to the Vision Zero strategy.

As a nonprofit association with more than 200 member organizations throughout Germany, the DVR includes many stakeholders. Among these are employers' liability insurance associations (BGs), the public sector accident insurers, the federal government and the federal states, the German Road Safety Volunteer Organization (Deutsche Verkehrswacht), the automotive and automotive supply industry, and many more. Many other institutions soon joined and explicitly committed themselves to the Vision Zero strategy. Due to the proximity of the DVR to the employers' liability associations, Vision Zero also received considerable support in the area of occupational safety, as it has also done in many other parts of the world.

The DVR's decision was based on the conviction that the death toll on German roads was unacceptable. The number of road accident victims in Germany has been recorded by the Federal Statistical Office since 1953. Since then, a total of 736,000 people have been killed in road accidents in Germany. This is more than the number of inhabitants of the city of Frankfurt am Main. Even now, when the number of road accident fatalities has reached an estimated historic low of 3,090 in 2019, on average 8.5 people die in road accidents in Germany every day.

Let us imagine that cars had not yet been invented. Someone then came and explained to politicians, the media, and the general public in Germany that they had invented an entirely new technology which puts personal mobility on a completely new basis thanks to motorized, individually controlled vehicles. However, the introduction of this technology would entail a new type of accident, namely road accidents. According to their estimate, this would involve a daily average of 8.5 fatalities. It should be obvious that this new technology would never be introduced, and that the inventor's proposal would be rejected and perhaps even cause outrage. Who could justify introducing a technology that would cause 8.5 fatalities every day? Politicians, society, and the media would be unanimous in their rejection.

The decision to adopt Vision Zero also has a constitutional background. The right to life and physical integrity, which is precisely what Vision Zero demands, is a central concept in the constitutional law of the Federal Republic of Germany. Protection of this right is the responsibility of state bodies. The legislature and the executive are required to do all that is necessary to prevent infringement of this constitutional right. In view of the many options which are available, it is questionable whether the traditional traffic safety policy, which accepts a considerable number of deaths and severe injuries as unavoidable, provides such protection.

Road users cannot achieve traffic safety on their own. It is the duty of the state and industry to develop a safe traffic system. However, this does not eliminate individual responsibility. Each and every one must be aware of the risks which they create for others by their actions or failure to act. Individuals are responsible for compliance with laws and regulations, while the developers of the system must ensure that the system as a whole is safe. Developers of the system primarily include the authorities that are responsible for building and maintaining roads, vehicle manufacturers, transport operators who transport goods and passengers on a commercial basis, as well as politicians, the legislature, the judiciary, and the police. This systemic view in Vision Zero is perhaps the most important change as compared to the previous view, which considered individual road users to bear the primary responsibility.

The German Road Safety Council cannot pass legislation, and it does not build roads or vehicles. However, it can make demands with regard to these points. Together with its member organizations, the DVR has developed the following list of ten top measures to be implemented by government, municipalities, and industry. The DVR is convinced that these measures will rapidly reduce the number of deaths and serious injuries due to road accidents. Some of these measures will take some time, whereas others can be rapidly implemented.

## Increase in Targeted Traffic Enforcement

- Appropriate improvement of the financial and personnel resources of the police and the corresponding state organizations, including improved training
- Increased prevention and prosecution of traffic violations by means of better cooperation between authorities
- Implementation of model trials with section control (a speed control system that measures the average speed of vehicles over a road section of typically 2 km or more)

## Adaptation of Maximum Speeds

- Reduction of the maximum speed on rural roads with widths up to and including 6 m to 80 km/h
- Enforcement of overtaking prohibitions on rural roads in areas with restricted visibility for overtaking

- Implementation of trials for the reduction of urban speed limits from 50 to 30 km/h
- Introduce general speed limits for all vehicles on German motorways; promote the expansion of intelligent traffic systems

### Prevention of Accidents with Trees

- Design of roadsides of rural roads without obstructions
- In the case of existing trees, increased use of passive protection in critical areas
- Reduction of the maximum speed limit for tree-lined roads and efficient monitoring of compliance

### Improvement of Safety for Motorcyclists

- Extensive implementation of the information leaflet for improvement of the road infrastructure for motorcyclists (MVMot 2018) in all federal states
- Improvement of the visibility of motorcyclists

### Increased Safety Through Improvements of the Infrastructure

- Consistent application of proven infrastructure measures
- Ensurance of the use of the instruments of road safety inspections, accident commission, auditing of the status quo, and safety audits
- Improvement of safety at intersections, road junctions, and roundabouts

### Promotion of Driver Assistance Systems, Automation, and Networked Driving

- Consistent promotion and installation of safety-enhancing driver assistance systems in vehicles
- Utilization of the proven safety potentials of automated driving functions and networked driving

### Increased Safety for Pedestrians and Cyclists

- Improvement of the infrastructure for pedestrians and cyclists
- Improvement of the visibility of pedestrians and cyclists
- Promotion of helmets for cyclists and riders of electric bicycles
- Development and mandatory use of turning assistance systems
- Promotion of the “Dutch Reach”

### Prevention of Driving Under the Influence of Alcohol and Drugs

- Enforcement of the prohibition of driving under the influence of alcohol
- Introduction of alcohol interlock programs
- Introduction of a traffic offence for cyclists with a blood alcohol level of more than 1.1

### Improved Qualification of Novice Drivers

- Promotion of the accompanied driving scheme
- Introduction of mandatory extensions of learning times for novice drivers
- Development and mandatory introduction of a curriculum for driver training

### Reduction of Hazards Due to Distractions

- Promotion of a change in behavior in the use of information and communication systems (including smartphones)
- Exploitation of all technical options for reducing risks due to distractions

## Political Implementation (Guido Zielke BMVI)

Since the 1950s, traffic trends in Germany have been heading in one direction only – upward. With the fall of the "Iron Curtain" and German reunification, this trend was given a further boost. Thus, for instance, freight traffic on German roads increased by over 27% from 2000 to 2010. In the same period, there was a rise of over 6% in the volume of private motorized transport.

An end to this trend is not in sight. The Federal Ministry of Transport's traffic forecast predicted an increase in road haulage by 39% from 2010 to 2030, and at the same time an increase by 10% of passenger traffic. This seems to become true, judging by current trends. In the last ten years alone, the number of motor vehicles in Germany has increased by around 14%.

However, in spite of the increased intensity of road traffic, German road safety has improved considerably. The federal government, federal states, and local authorities have for decades undertaken major and successful action to reduce the number of people killed and severely injured. In 1970, over 21,300 people lost their lives on the roads, whereas that figure had fallen to 3,046 by 2019. That is a drop of more than 85%.

This success in improving road traffic in spite of intensified traffic has been based on two working principles: First, concentrating on measures whose effectiveness have been proved by academia and, secondly, focusing on what is most likely to be successful. An example can show what this means. Newly qualified drivers are by their very nature a high-risk group, not just in Germany. In many cases, the risk inherent in being a novice driver is compounded by the risk inherent in being a young person. In other words, they are involved in far more fatal accidents than what would be assumed given their share of the population. It was thus obvious that there was a requirement for action here. One approach to solving the problem was to lengthen the learning phase of normal driver training.

However, although driving schools are naturally keen to sell more driving lessons, many young people cannot afford them. So, what about parents and other experienced drivers helping out by acting as lay instructors? As an incentive to allow themselves to be accompanied while driving, a kind of "advanced driving license" could be obtained earlier. However, the minimum age of 18 years for driving unaccompanied would remain unchanged. That was the idea.

In 2004, the first trial schemes for what was known as "accompanied driving from seventeen" were launched. The Federal Highway Research Institute evaluated the trials and reached an opinion that, for academics, was surprisingly unanimous. In the first year of unaccompanied driving, drivers who had taken part in the scheme were involved in 17% fewer accidents and committed 15% fewer traffic offences. If mileage is taken into account, the risk of being involved in an accident fell by 22% and the risk of being caught committing a traffic offence fell by 20%. In purely mathematical terms, the scheme prevented around 1,700 personal injury accidents in 2009.

Following this unambiguous outcome, the Federal Ministry of Transport acted. Since 1 January 2011, accompanied driving from 17 has been part of permanent legislation. Participation in the "Accompanied Driving" scheme is voluntary and has to be explicitly applied for. The normal minimum age at which a driving license can be obtained remains 18 years. The scheme has been a continuous success story, as the academic study predicted. The federal government and the federal states have now joined forces in an attempt to encourage more young people who wish to drive unaccompanied as soon as they reach the age of 18 to participate in the "Accompanied Driving" scheme.

Thus, the academic-based approach and the concentration on the most important fields of action have proved very successful. This is also the approach that the Federal Ministry of Transport applies in developing a new vision for the future of road safety activities in Germany.

On the global level, the 2010s were declared the "Decade of Action for Road Safety" in the "Moscow Declaration." The European Commission followed suit with its "Policy Orientations on Road Safety 2011-2020." Both documents contained an undertaking to halve the number of road deaths. The EU's long-term goal is now to move close to zero fatalities by 2050. Its third Mobility Package set the interim target to reduce the number of road deaths by 50% between 2020 and 2030. In the "Valletta Declaration," Germany, along with the other EU Member States, expressed its support of this target. Given what has already been achieved, the efforts involved in achieving further reductions will increase disproportionately as each further advance is made. There are no easy solutions any more.

The federal government is leading the way in the work to reduce fatalities and serious injuries on German roads. In its new road safety program, which covers the period from 2021 to 2030, it will set out measures that are within its remit. However, an important lesson from the past ten years is that is it not sufficient for each of the federal government, federal states, and local authorities to consider only its own measures. The new vision for the future of road safety is therefore linking together all stakeholders in jointly establishing the overarching objectives and determining the specific fields of action. This gives rise to effective measures that complement and build on one another. Against this background, the federal government is currently compiling its own measures in the next road safety program, which will cover the period from 2021 to 2030. The federal states and local authorities are also engaged in similar processes. This approach was supported in the 2018 Coalition Agreement, in which the federal government committed to Vision Zero in the medium term. Vision Zero refers to a shared responsibility. The German aspiration is to bring all parts of society together in the interests of common road safety activities and to unite them in a common strategy with a common vision. This includes the federal government, federal states, local authorities, and all other key stakeholders in road safety. Towns and cities, in particular, are key players, especially with regard to vulnerable road users such as pedestrians and cyclists. Trade associations, industry, and individual businesses can also make most valuable contributions.

The fields of action on which all road safety stakeholders in Germany agree include to tackle accident blackspots and to address all road users. Important measures are improving the road safety of cyclists, pedestrians, and the elderly, and mitigating the effects of accidents. It will also be necessary to deal with the increasing automation of motor vehicle traffic, as well as other megatrends, such as the digital revolution, globalization, and connectivity, which are transforming society, and thus also mobility. Each field of action can be bolstered by far-reaching measures taken by different players. The objective is to enhance road safety in each field of action by means of measures that are dovetailed as closely as possible and complement one another in the spheres of infrastructure, automotive engineering, or human behavior. With regard to safe cycling, for instance, the infrastructure at junctions is crucially important. Another infrastructure challenge is the increasing speed of cycles as a result of electric mobility. As far as the objective of preventing accidents involving turning vehicles is concerned, the focus will continue to be on the use and the developments in the field of automotive engineering. At the same time, there will consistently be a need to adapt the law governing road user behavior, for instance, to cover new forms of mobility such as the electric scooter. The objective is to decouple the trend in the accident and casualty figures from the desired trend in the volume of cycling as an ecological, active, and modern form of mobility. In the field of cycling, greater consideration has to be given not only to actual objective risks but also to cyclists' subjective feeling of safety. This is just one example of how broad-based and complex the measures involved in a field of action can be.

With the specific fields of action, Germany is breaking new ground in addressing target groups and issues. In addition, the federal government is increasingly focusing on improving the measurability of road safety. In the next decades, new indicators will be added to existing ones, such as the seat belt wearing rate and the percentage of cyclists wearing helmets. In addition to indicators relating to the vehicle fleet and the infrastructure, an indicator of road user culture will be developed. The new measures will provide information on the effectiveness of different measures that the current official accident statistics does not deliver. This approach represents the continuation of the course of action practiced for years of a road safety policy based on evidence and academic research.

The new vision for the future of road safety in Germany will also bring another new feature. Supported by additional data produced in part by the new indicators, the federal government will conceive its road safety program as a living system. If we think of the electric scooter or automated and connected driving, it becomes clear that the changes to our mobility are occurring at an increasingly rapid pace. The German Federal Government wishes to be able to take action at any time to promote Vision Zero. Necessary adaptations of the measures are to be continuously reviewed. The guiding principle that every fatality is one too many will not only be confirmed but also receive new impetus in the new decade as a result of the actions described above.

## Research for Safe Cities (Clemens Klinke DEKRA)

For almost 100 years, DEKRA, the German Motor Vehicle Inspection Association (Deutscher Kraftfahrzeug-Überwachungsverein), has been working for safety on the road. This is the purpose for which it was founded in 1925, and it still has not changed. Although the scope of DEKRA's efforts for a safe world has widened over the decades, improving road safety is still – and will continue to be – its central objective. Its major purpose is to help all stakeholders in road safety with concrete recommendations for improvements and solutions. DEKRA was one of the first signatories of the European Road Safety Charter, and it has supported Vision Zero from the beginning.

Some have argued that Vision Zero is a utopia, an illusion, a goal that cannot realistically be reached. While this should never be an argument for not even trying, DEKRA's approach has been that like other major projects, Vision Zero should start with first steps. What if every institution concerned with road safety set their own "small" target? For example, should not a trucking company set the target for itself to get through the year without any crashes involving physical injury? Should not a regional council strive to reduce the number of crashes, tackling one accident black spot at a time? The combination of all such targets would take us gradually closer to Vision Zero. The 2014 DEKRA Road Safety Report specifically focused on urban mobility and asked the question: Would Vision Zero be achievable within the comparatively manageable framework of one town or one city? (DEKRA Road Safety Report 2014 Urban Mobility, Strategies for preventing accidents on European roads, Stuttgart (Germany), 2014 – available from www.dekra-roadsafety.com)

DEKRA Accident Research, working closely with members of the OECD's International Traffic Safety Data and Analysis Group (IRTAD), has been analyzing crash statistics from towns and cities with more than 50,000 inhabitants. The figures from the years 2009 to 2012 for 17 European countries showed even then that no less than 48% of the 971 towns and cities with over 50,000 inhabitants had achieved the goal of no road fatalities in at least one year. Among them were also larger cities with a population of more than 100,000 or even 200,000. The conclusion in the 2014 DEKRA Road Safety Report was that, although there is still quite some distance to go in order to achieve Vision Zero as a whole, there were millions of Europeans already living in towns and cities without any deaths caused by road crashes in built-up areas.

To make this fact known, an interactive online map was created, which has been updated and expanded over the past years with more and more data. (DEKRA Vision Zero Interactive Map, www.dekra-vision-zero.com) Today, it features 26 countries, with its scope expanded beyond Europe to include data from, among others, Australia, Canada, Japan, Mexico, and the USA. Of the 2,975 cities analyzed worldwide, a total of 1,197 – or 40% – have achieved the goal of zero road fatalities at least in one year since 2009.

With the interactive map, users can filter results by country, by city population, by calendar year, by the number of zero years, or any combination of these criteria, giving in-depth insight into the degree to which Vision Zero, in terms of road deaths, is being achieved in cities around the world.

Results vary considerably from region to region and from country to country. In Mexico, the share of “zero cities” is just 6%, in Japan it is a little over 20%, in the USA 24%, and in Australia some 28%. The European picture looks better, as a whole, with 68 % of cities over 50,000 inhabitants having achieved zero road fatalities at least once. While in some European countries the percentages are comparable to those in the USA or Japan, there are others where a very large majority of 50,000+ cities have already been successful – e.g., the UK (68%), Switzerland (70%), France (75%), Germany (79%), Spain (83%), the Netherlands (86%), and Sweden (95%). The percentages are based on available data within the period from 2009 to 2018 or 2019, respectively.

Many cities have achieved zero road fatalities more than once, 147 of them even in six or more years. The largest share of these cities is to be found in Europe, but also Mexico (1), Japan (1), and the USA (3), among others, have cities with six or more zero years. Among the “zero cities” around the world, there are almost 270 with a population over 100,000 and almost 40 with a population over 200,000.

By far the largest city with one zero year is Gothenburg (Sweden) with almost 550,000 inhabitants. Other large cities who have reached the goal at least once are Espoo (Finland), Aachen (Germany), Granada (Spain), Rennes (France), Jerez de la Frontera (Spain), and Mainz (Germany). The UK has a particularly large number of “zero cities” with a population of over 200,000, e.g., Nottingham, Newcastle, Derby, Southampton, Portsmouth, Brighton and Hove, Reading and Northampton, as well as the London Boroughs of Wandsworth and Bexley. Most of the successful 200,000+ “zero cities” are European, but some can also be found in other world regions, such as Fuchu (Japan), Buenavista (Mexico), and Oxnard (California, the USA).

To honor especially successful cities for achieving zero road crash fatalities, and to draw attention to Vision Zero as a concept, the DEKRA Vision Zero Award has been presented every year since 2016 to a city with a string of zero years. Recipients so far have been Kerpen (Germany, 6 zero years in a row), Torrejón de Ardoz (Spain, 7), Bad Homburg (Germany, 8), Lüdenscheid (Germany, 7), and, most recently, Siero (Spain) with no less than 11 “zero years.”

The award recipients, as well as almost 1,200 other towns and cities around the world, are testament to the fact that, 20 years after its conception, Vision Zero can by no means be called an illusion or a utopia never to be reached. Of course, it has not yet been completely turned into reality. However, the analysis shows that the goal can be achieved within an urban context and is in fact already being achieved year after year in hundreds of cities across the globe.

This should provide extra motivation among all road safety stakeholders not to give up their efforts to edge ever closer to Vision Zero. This applies to cities that have not yet been able to register any zero years, as well as nonurbanized areas in other contexts of traffic. It also includes going beyond road deaths to also cover severe injuries.

In the future, automation will play an ever-increasing part in our vehicles and in traffic as a whole. Some have claimed that given the high share of crashes caused by human error, automated driving will be the solution of all road safety problems. This might seem plausible at first glance – however, things will probably not be just as simple as that. No doubt, automated driving has the potential to help avoiding accidents and to reduce the number of deaths and severe injuries on our roads. Sensor technology as well as vehicle-to-vehicle and vehicle-to-infrastructure communication can play out their strengths where human drivers might reach their limits. However, automation will only be beneficial if both the vehicle itself and its communication with other vehicles or the surroundings work reliably throughout its life cycle. This needs to be monitored and tested independently.

In the past and up to today, human drivers have been tested and regulated: They need a driver’s license, they are restricted in terms of alcohol consumption and other factors, and professional drivers are required to undergo regular further training and tests. At least the same degree of thoroughness will have to be applied to testing and regulating the “virtual driver,” i.e., systems of automated driving, if we do not want to compromise road safety. This will have to be part of the homologation of new vehicles, as well as periodical technical inspections (PTI). In both these processes, systems of automated driving will have to undergo in-depth checks to make sure they work safely. DEKRA and other organizations have made the case that, especially for PTI, inspectors need to have independent and unfiltered access to vehicle data relevant for the inspection. Building the legal framework for this will be one of the major tasks for regulators in the coming years.

With regard to automated driving, road safety is at a crossroads, so to speak. If handled sensibly and responsibly by all parties concerned, automation has the potential to improve road safety quite significantly. If decision-makers let things slide, however, automated driving can be rather counterproductive and predominantly create new dangers. Nobody advocating Vision Zero should be willing to let this happen.

## Munich: A City on Its Way to Vision Zero (Matthias Mück and Martin Schreiner, Mobility Department, City of Munich)

Munich is a rapidly growing city with around 1.5 million inhabitants. Its surroundings have a population of around 3 million people. The road safety level is close to the national average: 46.000 accidents took place in 2018, 17 persons died, 619 were seriously injured, and 5.891 slightly injured. To improve this situation, the Munich City Council decided (on the recommendation of the municipal road administration) on April 25, 2018, to adopt the Vision Zero according to the recommendations of the German Road Safety Council (Deutscher Verkehrssicherheitsrat) as the official fundament and strategic goal of the road safety work of the City of Munich. This decision included the political mandate to develop an ambitious program improving and modernizing the municipal road safety work fundamentally. Essential basis for this challenge was an expert's report compiled by PTV Transport Consult GmbH, and supported by the Institute of Forensic Medicine of the Ludwig-Maximilians-University Munich. Both analyzed the current road safety work in detail and developed comprehensive recommendations to improve it. This measure had been subject to several city council decisions in 2019, including the allocation of resources for its long-term implementation. The most important action fields and measures are:

### Improvement of the Data Basis

One key element of the Vision Zero implementation is the improvement of the accident data analysis by using new software products. As of now, police accident data can be analyzed in detail according to accident severity, type, location, and constellation of accidents, but also combined with several further criteria, such as time, weather, or specific target groups. This creates conditions for a more thorough local accident analysis and for the development and implementation of specific and effective measures.

This software is also able to combine accident data with further traffic and infrastructure data, allowing the identification of risk areas within the existing road network that are in need of preventive measures. Additionally, the evaluation of planned infrastructure measures with respect to expected accident consequences is an essential innovation to consider road safety issues at a very early planning stage of networks, sections, and all kinds of infrastructure.

A weakness of the current data analysis is that only accidents registered by the police are used. This excludes accidents that are not registered by the police, but only by, e.g., hospitals or insurance companies. Therefore, the City of Munich launched a pilot project in cooperation with hospitals and insurance companies to investigate the high number of unreported accidents (especially in cycling), which is still a largely unknown field of road safety.

## Systematic Mitigation of Accident Black Spots

In addition to the activities of the municipal accident commission that intervenes after fatal accidents or noticeable accumulations of accidents at specific locations, the 50 most dangerous intersections will be identified in regular rotation and monitored in the abovementioned data analysis with up-to-date police accident data. They will be subject to mitigation measures that may include speed reduction and optimized traffic control, as well as a complete reconstruction of crossings in order to obtain clear sight lines and a more understandable road design.

To highlight one important example: Turning accidents are a dominant accident type, especially at intersections. At this point the administration itself serves as a model. Currently, 90% of all municipal trucks have turning assistance systems to prevent turning accidents with cyclists and pedestrians. In addition, subcontractors using trucks are bound by contract to have such a system.

## Strong Prevention Work

Prevention is a crucial pillar in the Munich road safety work and necessary requirement for the successful implementation of the Vision Zero concept. Within the first years we prioritize our prevention work on clear focus areas with a high safety potential.

- *Setup of a safety audit entity:* Main objective is to evaluate every infrastructure plan by a certified road safety auditor to ensure the involvement of road safety aspects in the earliest possible stage of infrastructure planning. Furthermore, the systematic evaluation of existing infrastructure concerning road safety aspects will be also part of the foreseen audit entity. Therefore, we will hire and train extra staff in the near future.
- *Implementation of safety performance indicators (SPIs):* The assessment of the road safety situation, as well as its development on the basis of casualties and/or accidents, is not without problems. Accidents are influenced by a number of factors (e.g., weather effects) and these influences can also overlap. Hence, assessing the causal relationship between road safety measures and the occurrence of accidents is limited. This also applies to the timeline. Certain measures might show their effects only after a longer period of time. Safety performance indicators reflect a mediating level between road safety measures and the final result of road safety efforts in the form of accidents, injuries, or fatalities. In 2021 the City of Munich will develop first suitable indicators (i.e., speed measurements to determine the effectiveness of speed limits) to ensure comprehensive measure evaluation.
- *Public relations:* A permanent road safety campaign will be implemented in 2021 as part of an overall communication concept for promoting sustainable mobility.

The road safety campaign will focus on special topics, such as collisions between a cyclist and a motor vehicle's door, but also on general issues such as a more respectful behavior on the road and a more relaxed collective spirit. It will be combined with a city-wide target group–oriented information, consulting, motivation, and training program. Main focus groups are vulnerable groups like school children and elderly people.

*Safety on the way to school:* A new digital portal for planning safe ways to school is available since the end of 2020. The portal provides information about school locations, school districts, signalized intersections, and the positions of available assistants on the way to school, helping school children crossing the street.

Fortunately, the Munich City Council did not only approve the Vision Zero as the new official strategic objective, it also launched a concrete implementation program and provided necessary resources. Altogether 15 new jobs in road safety have been created, and a yearly budget of 2.5 million Euros was established. Moreover, programs and resources in other fields of activity within the mobility sector will focus more on road safety.

There are four major reasons why Munich was able to implement this ambitious Vision Zero program.

1. Motivated, competent, and personally engaged people in the city administration with good contacts to science, consultancy, and policy. They prepared the topic in the background over several years and took any arising opportunity.
2. The City of Munich had excellent consultants, who worked out the foundations of the described concept.
3. In 2016 the Department of Safety and Public Order got a new head, who put road safety very high on his agenda.
4. Finally, and unfortunately, some very serious accidents occurred. Following media reports and public pressure also prepared the ground for a resolute political decision.

Main task in the upcoming two to three years will be to get this program fully started. Specialists have to be employed, software has to be fully implemented, and trainings have to be conducted. New working structures and processes have to be implemented. External support has to be organized. Considering the very special environment of a public administration, the high number of tasks in a rapidly growing city like Munich, and the high expectations of politicians and the public, the implementation of Vision Zero is a major challenge. That is why the City of Munich systematically seeks for external cooperation and support, especially for a close exchange of experiences with comparable cities and interested institutions.

## The Need for Technology Assessment: E-scooters as an Example (Kurt Bodewig DVW)

### The Need for Technology Assessment: E-scooters as an Example

Technology assessment (TA) originated in the 1960s in the USA. It "serves to identify and evaluate the consequences of the use of technology for society through scientific analysis. It is concerned with the systematic identification and assessment of technical, environmental, economic, social, cultural and psychological effects that are associated with the development, production, use and exploitation of technologies. The idea of TA is to be able to anticipate in advance the consequences of technical actions and thus to make the thorny path of trial and error at least less painful, if not to avoid it completely." (Wirtschaftslexikon24.com 2018 p.1.) Within the framework of the policy of humanizing work, technology assessment was also applied in Germany in the beginning of the 1970s. Scientists and TA institutions in Europe have joined forces to form the European Technology Assessment Group (ETAG). Since 2005, ETAG has supported corresponding technology assessment projects on behalf of the European Parliament for the STOA Committee (Science and Technology Options Assessment) since 2005. In Germany, this task is carried out by the Office of Technology Assessment (TAB) at the German Bundestag.

Technology assessment is important for many political decisions. Especially with a strategy of Vision Zero, every change in the mobility system should be precisely analyzed for its effects and checked in terms of Vision Zero. This is exemplified by the introduction of electric micro-vehicles on urban streets and roads of Germany.

In urban agglomerations, there is a high volume of traffic. For this reason, mobility offers must be expanded to provide alternatives, especially for users of private cars. In addition to bicycles, so-called micromobility is seen as a solution, whereby commuters, for example, leave their cars at home and cover the "first and last mile," i.e., the journey from home to public transport and from public transport to work, with a much smaller and more economical vehicle. This is the role of the e-scooter, a battery-powered, single-track vehicle with a handrail. Its approval in the Federal Republic of Germany was published in the Federal Gazette (Federal Gazette Part I 2019 No. 21) on June 14, 2019, by the Electric Micro-Vehicles Ordinance (eKFV). It came into force on June 15, 2019. (Bundesministerium der Justiz und für Verbraucherschutz – Bundesamt für Justiz: Verordnung über die Teilnahme von Elektrokleinstfahrzeugen am Straßenverkehr (Elektrokleinstfahrzeuge-Verordnung – eKFV)) With this decision, the prerequisites were created for electric micro-vehicles with steering or holding rods to participate in road traffic. The vehicles must be equipped with two independent brakes, a lighting system, and an acoustic warning device (bell). The drive power must not exceed 500 W, and the maximum driving speed is 20 kph. For operation in Germany, the vehicles must have a general operating permit from the Federal Motor Transport Authority (Kraftfahrtbundesamt, KBA). In addition, users must take out liability insurance and affix an appropriate insurance plate to the vehicle. The allowed traffic areas are cycle paths and roads, and the minimum age is 14 years. The use is also subject to further regulations for driving vehicles, such as strict restrictions against driving under the influence of alcohol and drugs.

Despite criticism of individual regulations, the road safety associations agreed unanimously to the proposed approval on the basis of its risk/opportunity assessment. A draft ordinance was introduced into the legislative procedure just one month later. It was weakened in terms of road safety, in ways that significantly increased the potential danger. At the hearing in the German Parliament (Bundestag), criticism was correspondingly strong. Although negative experiences from other countries, including road deaths, serious injuries, greatly increased aggression, and displeasure in the population, were pointed out, they had no discernible effect on the federal government. Following protests by the DVR and DVW and other associations, some attempts to weaken safety rules, such as the planned use on footpaths and lowering of the age of use to 12 years, were withdrawn in consultations with the states.

However, the technology assessments of the Federal Highway Research Institute (BAST) were not sufficiently taken into account. Parliamentary technology assessment was not carried out because the regulation did not require a parliamentary decision. A proposal by traffic safety associations to require drivers to be suitable to drive motor vehicles was rejected. It would have led to a minimum age of 15 years and to a requirement of proven knowledge of the rules of the road, shown, for example, by means of a moped license. Since this proposal was not adopted, the current legislation allows 14-year-olds to drive a motor vehicle without special requirements.

The exact regulations for the introduction of electric micro-vehicles were not sufficiently communicated to the public in advance, and there was widespread ignorance of which e-scooters were allowed and how they could be used. There were already many privately owned electric micro-vehicles that did not have a permit and were therefore not allowed on public roads. Many believed that they were legalized by the regulation, and so vehicles without handlebars, sometimes self-balancing, were driven, often on pavements and at considerably more than 25 kph, without insurance coverage.

Vehicles that complied with the technical regulations were not privately owned at first but were offered by rental companies in large cities and in large numbers. In Berlin alone, six national and international suppliers of e-scooters were represented by the end of 2019. Since Berlin had not set an upper limit like other large cities, after half a year there were more than 15,000 scooters in the city area, mainly near the center.

The number of users was correspondingly high, and after 6 months of registration of e-scooters in Germany, there was a massive deterioration in the traffic climate and an increase in the number of accidents with injured people, some of which were seriously injured, an extremely high increase in alcohol offences and a massive increase in rule violations. This was confirmed in accident reports from the police and in news media.

- In Berlin, 176 traffic accidents were registered by the police from the introduction of the e-scooters until September 30, 2019, alone. In these accidents 131 people were injured, 21 of them seriously. By October 16, there were more than 1,200 proceedings concerning traffic violations in connection with e-scooters. In 108 cases the drivers were under the influence of alcohol, in 22 cases under the influence of other drugs. In addition, by the end of November 2019, there were more than 1,200 reports of incorrectly parked e-scooters in the Berlin-Mitte district alone. Almost all of these were violations of the road traffic regulations.
- In North Rhine-Westphalia, a total of 116 accidents have been recorded since the official permit for e-scooters was issued. Almost 1,500 administrative offences have been registered.
- In the Saxon state capital of Dresden, e-scooters are now responsible for more than half of all alcohol offences on the road. Between August and October 2019, the authorities counted 217 offences committed by e-scooter drivers involving alcohol.
- By the end of 2019, the police in Erfurt, the capital of Thuringia, had reported almost 170 cases of scooters being driven under the influence of alcohol. One in two of these cases was a criminal offence with over 1.1 per mille. Sixteen people had been caught under the influence of drugs.
- A sanction was imposed by the district court of Hanover against an e-scooter driver (age 22) for drunk driving. The young man had driven through the pedestrian zone with 1.2 permille. He lost his driving license and has to pay an additional penalty of 1,250 €.
  - MDR (20.12.2019): "E-Scooter in Mitteldeutschland-Viele Alkoholverstöße und Unfälle mit E-Rollern"
  - WDR (09.01.2020): "Schwerverletzte bei E-Scooter-Unfällen in NRW"
  - RBB (12.11.2019): "Rund 15.000 E-Scooter rollen durch"
  - Berlin- Tagespiegel (20.11.2019): "Mehr als 1200 Anzeigen in Berlin-Mitte gegen E-Scooter"
  - dpa/Redaktionsnetzwerk Dtschl.- RND (12.01.2020): "Studie: E-Scooter Unfälle führen oft zu Kopfverletzungen" [USA]
  - UDV-Blog (08.07.2019): "E-Tretroller: Laufen lassen oder intervenieren?"

These breaches of the rules not only lead to administrative costs, but also threaten the safety and protection of people, especially the drivers themselves, and also crowded pedestrians with injuries that are often more severe for elderly people. Statistically, e-scooter accidents are not recorded separately.

According to a newspaper article, serious head and face injuries occur, especially when alcohol is involved. This was reported by Marc Schult, a chief physician at the Clinic for Trauma Surgery, Hand Surgery, and Orthopedics in Hanover: "According to my observations," he said, "the number of pedestrian accidents is currently higher for e-scooters than for bicycles. Since mid-September we have treated around 50 patients in my clinic alone." Typical injuries in e-scooter accidents are fractures of the wrist, elbow, and ankle. "In the case of drunken drivers, we find more serious injuries, in particular craniocerebral trauma and fractures of facial bones, such as the nose, zygomatic bone or jaw." Schult pleads for compulsory wearing of helmets to reduce the dangerous head injuries.

This is confirmed in a recent study from the USA published in the medical journal *Jama Surgery*. ("Jama Surgery" 2019, dpa 11.01.2020) It showed that the number of injuries and hospital admissions after accidents with e-scooters has increased dramatically. About a third of the patients suffered head trauma, twice as many head injuries as cyclists in the USA. More than a quarter suffered fractures, similarly frequent bruises and abrasions, and one in seven suffered cuts. The authors of the study admit that there is probably a high number of unreported accidents. They strongly recommend a helmet, since only 2–5% of the users, which were treated in hospitals, wore a head protection and whoever provides e-scooters should promote helmets and make them more accessible.

In addition to accidents, there are other effects, such as the increasing aggression in the traffic climate due to the reckless behavior of e-scooter drivers, who crowd pedestrians and leave the vehicle on sidewalks. Pedestrians, especially old and disabled people, are left with a feeling of insecurity. At the parliament's hearing, the German Federation of the Blind and Partially Sighted rightly warned of the dangers.

Since January 1, 2020, the involvement of e-scooters has been separately assessed and recorded when reporting accidents. This is the first time that valid data on perpetrators, victims, and serious consequences of accidents have been collected. The police, who have already recorded e-scooter accidents in various regions, now produce these reports according to a uniform system.

The Federal Statistical Office (Destatis) published first statistical data for 2020. There were 2,155 accidents recorded throughout Germany involving e-scooters, which harmed people. Most of them caused slight injuries, 386 people were seriously injured, and 5 e-scooter-users lost their lives. In comparison to other vehicles these numbers seem to be less alarming but keeping the special conditions of e-scooters in mind, there is a reason for worrying. We assume that there is a higher number of unreported incidents and the e-scooters are a rather new form of mobility with fewer vehicles in use. Also due to the Corona pandemic in 2020 significantly less tourists visited cities, who are the main target group for the rental services. This made the rental companies to reduce their fleets temporally. It means, we have to presume, that under "normal" conditions and development the number of accidents would be a lot higher.

But from these data we could already see that there is a higher accident risk for e-scooter users in comparison to bicycles, which are the nearest group of road users. They both are unprotected, traveling with a similar speed, use the same road types such as bike lanes, and do not make any kind of driving license necessary. E-scooters also injure more often other persons – especially pedestrians – involved in relevant accidents than cyclists do.

One of the reasons is that e-scooter users violate important regulations more often, which is also attributed to the special circumstances of the rental system. It aims predominantly to a spontaneous decision to drive – mainly by tourists. We guess that they are less experienced in safely driving the scooters and/or there is an ignorance of the local regulations such as the prohibition to use the sidewalk. Some want to save money while renting and use the vehicles with two person or they carry heavy luggage. Especially party-seeking tourists see the rental system as an opportunity to manage shorter distances faster than by foot and more convenient than using the public transport – while anything else but sober. Most frequent cause of accident in 2020 was the influence of alcohol in about 18% of the cases. Furthermore, visitors are not equipped with protective gear as a helmet and rental companies do not provide them.

These indications contrast with the usage of e-scooters in everyday life and regular frequency like for commuters. Here we expect another age structure, more driving experience, more reasonable and right behavior, higher potential for using a helmet, etc. So, there is an appropriate implementation of e-scooters, if we use it as a replenishment to our mobility to ease traffic congestion while keeping sustainability in mind.

With these findings, a (lesser) form of TA will be carried out retrospectively. Whether and when these findings will lead to a necessary change in the legal situation is not yet foreseeable.

All this could have been avoided with an appropriate technology assessment. We can learn this from the experience of technology assessment in Montreal (Canada). When Montreal was faced with the decision whether to approve e-scooters, a technology impact assessment was carried out. It was based on a pilot project in which rental of e-scooters was allowed on a limited scale.

The evaluation of the pilot project showed that hardly any e-scooter driver adhered to the traffic rules. An extra police unit would be needed to cope with the many rule violations. Although the drivers were required to wear a helmet, almost none of them did so. In 80% of the cases, the e-scooter driver finished the rental by parking the e-scooter illegally. Based on this real experience and its scientific evaluation, it was decided not to perform any additional pilot projects. The small electric vehicles were again banished from the cityscape again. Instead, it was decided to improve the supply of rental bicycles and to introduce additional licenses for e-bike rentals. The resulting income will be reinvested in the city's bicycle traffic infrastructure. (CTV News Montreal Wednesday, February 19, 2020.)

The design of the e-scooters results in high demands on safe handling. At the same time, the rental system means that many people are on the road for the first time without having practiced before. For this reason, the Deutsche Verkehrswacht (German Road Safety Association), with the support of the Federal Ministry of Transport, has included the topic in one of its target group programs and offered to give test courses.

The e-scooter is a sensible means of mobility for the journey between home and daily employment in order to bridge the so-called "last mile." Either in the combination of bus and train with e-scooter locations at stops and stations as a rental system or transportation in public vehicles, such as subways or regional trains or in buses. This also allows helmets to be carried, but also requires specific solutions. However, in order to avoid hazards, the carriage of electric vehicles in public transport buses is subject to special conditions. Only if the criteria for taking e-scooters on public buses are met, it is possible to transport them safely in local public transport vehicles. This should also be part of a TA.

Public platforms such as JELBI, which connects different rental platforms with Public Transport in Berlin, uses an app to sell tickets and rent complementary micro-electric vehicles for individual mobility chains. By the obligatory proof of the driving license for the receipt of the app access is also, e.g., the proof of the driving rules knowledge necessary for traffic safety reasons likewise documented.

Furthermore, the DVW advocates the following measures:

Cities that allow e-scooters will have to put stringent demands on providers of e-scooter rental. Reasonable measures to reduce accident risks include:

- A prohibition to park e-scooters outside of clearly defined parking spaces. This is needed to avoid accident risks for pedestrians.
- In order to make effective traffic-safety prosecution possible, rental companies should be required to collect the necessary user data and make them available to the law enforcement.
- Helmets should be mandatory in order to prevent severe head and brain trauma.
- The police must enforce compliance by building appropriate capacities (including building or expanding police bike teams).
- Alcohol controls, also with a focus on e-scooters, must become part of police activities. Previous cases of drunk e-scooter driving clearly show the necessity.
- The infrastructure needs to be significantly improved and expanded in order to reduce competition between cyclists and e-scooters.
- The technical equipment of e-scooters needs to be improved, among other things, by bindingly equipping future single-track, standing miniature electric vehicles with direction indicators.
- Other vehicle classes that pose a higher risk, such as self-balancing micro-electric vehicles or vehicles without a handrail, have to be banned.
- Additional scientific data are required to target accidents. The federal government should commission its research institution (BASt) to provide this data.
- All of this must be accompanied by road safety prevention that offers training for safe use and critically monitors developments.

In conclusion, if a sound technology assessment had been carried out prior to the entry into force of the regulation on the electric micro-vehicles, the current situation with serious accidents and chaos in the inner cities of urban and tourist centers could have been avoided. The procedure practiced in Germany in this case, with a draft bill being approved without a prior technology assessment, is the opposite of an action in the sense of the "Vision Zero" commitment. This should be a warning to all. When a new mobility element is introduced, a technology assessment must be carried out.

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# Vision Zero in Poland

# 12

Kazimierz Jamroz, Aleksandra Romanowska,
Lech Michalski, and Joanna Żukowska

## Contents



**Abstract**

Poland's experience of road safety work is relatively short. In the early 1990s road deaths soared to a staggering 8000 a year. A diagnosis found that Poland's lack of systemic road safety action was to blame for those figures. In response, the state set up road safety bodies and commissioned road safety programs. In 2005, Poland followed the example of Sweden and adopted Vision Zero as a far-reaching concept of changes in road safety. The work that followed helped to improve the situation and reach less than 3000 fatalities in 2015. Despite that, for years Poland has been notorious for its road accident deaths, which are some

K. Jamroz (✉) · A. Romanowska · L. Michalski · J. Żukowska
Gdansk University of Technology, Faculty of Civil and Environmental Engineering, Gdansk, Poland
e-mail: kjamroz@pg.edu.pl





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of the highest in the EU. Poland has had its share of both successes and failures. The results of road safety policies are still below the expectations and many problems have not been solved. Road accidents are not considered a major problem. As a consequence, they are low on political agendas and the institutions remain ineffective due to a sense of collective responsibility for road safety problems. Achieving Vision Zero will require many changes, learning from past mistakes, taking advantage of the experience of the best performing countries, and, above all, taking effective and efficient actions with their systematic monitoring.

This chapter is a summary of the last 30 years of road safety work in Poland. It presents a diagnosis of Poland's problems, an assessment of the policies so far, and the likelihood of achieving the assumptions of Vision Zero in the future. Building on this, recommendations are given on the next steps Poland should take to improve its road safety.

**Keywords**

Road safety · Poland · Vision Zero · GAMBIT · Program · Strategy · Scenario · Forecast

## Introduction

Between the late 1980s and early 1990s a political transformation of Poland was taking place. Just as many other Central and Eastern European countries, Poland was making a shift from socialist to capitalist economy. The period was marked by an astonishing increase in road accident fatalities. People wrongly assumed that this was inevitable simply because motorization was developing dynamically. State bodies with statutory responsibility for road safety could not agree more because it justified their lack of spending on better roads. After all, there were always other more important issues, or so it seemed at the time. There was no reaction from the public, either. After years of socialism, people were willing to pay the price for growing mobility even if it meant accidents and victims. It was not until a group of World Bank experts (Gerondeau 1993) published their report in 1992 that an honest and objective diagnosis of the Polish situation was made clear – the system failed to address the problems of growing motorization leading to the high number of victims. The report paved the way for tackling road safety problems in Poland head on. The first steps were taken and they were to appoint the National Road Safety Council and develop Poland's first ever road safety program known for short as GAMBIT 96 (Krystek et al. 1996).

Since 1991, which was a peak year with the highest number of fatalities in Poland, the situation has improved significantly. Road deaths have now fallen from the catastrophic 8000 in 1991 to less than 3000 in 2019. The reduction was achieved thanks to the new socioeconomic situation, which kept improving after the transformation, road safety policies, change in road user behavior, and the delivery of national road safety programs.

An important milestone at the time was Poland's accession to the European Union (May 2004) and the development and implementation of the National Road Safety Program for the Years 2005–2007–2013, called GAMBIT 2005 (Jamroz et al. 2005). The program adopted Sweden's Vision Zero as an ethically justified vision of road safety (Jamroz et al. 2006). By adopting it Poland committed to strive for zero fatalities in road traffic. In order to achieve this, the following demands need to be met:

- Human life and health are put above mobility and other goals of the transport system.
- Both politicians, planners, road designers and builders, teachers, journalists, policemen, road carriers, rescue services and road users are jointly responsible for road accidents and eliminating their consequences.
- The road system and vehicles are designed, built, and operated in such a way as to minimize and compensate road users' errors.
- The traffic safety management system has procedures and tools to meet the challenges posed.

The moment of adopting Vision Zero as a far-reaching vision of road safety can be recognized as the start of systemic road safety action in Poland (Jamroz and Michalski 2005; Jamroz et al. 2017).

Poland's experience of road safety over the last three decades has had its ups and downs. For years Poland has been notorious for topping the EU's most dangerous country rankings. The risk of becoming a fatality in Poland was 50% higher than the EU average and double that of the United Kingdom, Sweden, the Netherlands, and Denmark. The results of road safety treatments are below the expectations. Many problems remain unsolved such as excessive speed or a high number of pedestrian fatalities. Road accidents are still not seen as a major problem in Poland or given political priority. In addition, the relevant institutions do not produce results because responsibility for road safety is collective (Krystek et al. 2013).

While the country has had successful road safety policies, more needs to be done (Wegman 2007; Jamroz et al. 2019). As it works its way toward Vision Zero, Poland will have to make many changes, learn from its mistakes, and take advantage of the experience other countries have with tackling road safety problems. This sets the context for Polish road safety research (Jamroz et al. 2006, 2016; Jamroz 2011, 2013; Krystek et al. 2013; Gaca and Kiec 2016). It aims to:

- Evaluate the approach to road safety programs in Poland
- Identify the conditions and efforts which have significantly improved road safety
- Identify barriers to the full implementation of measures
- Identify the challenges Poland will face in the years to come
- Understand how likely Poland is to achieve Vision Zero

This chapter is a summary of the last 30 years of road safety efforts in Poland.

## State of Poland's Road Safety

### Changes Between 1988 and 2019

Over the last 30 years Poland's road safety has improved significantly. Since 1991, which recorded the highest number of road deaths in history at 7900, fatalities have been reduced nearly threefold to 2900 people killed in 2019 (Table 1).

Compared to other EU countries, the changes have not been quick enough with Poland topping EU lists over the last 18 years several times. In 2018, Poland was number four among the EU's most dangerous countries (Fig. 1). The risk of becoming a fatality in Poland is still 50% higher than the EU average (which is 49 fatalities per one million population in 2018) and double the risk in the United Kingdom, Sweden, the Netherlands, and Denmark (Fig. 2). The total number of fatalities in Poland, Germany, France, and Italy represented half of the entire European Union's road deaths in 2018.

### The Situation in 2018

Based on the police road safety database SEWIK, in 2018 there were 31,700 road accidents on Polish roads with 2865 people killed and 37,300 people injured of which 10,900 were seriously injured. The most frequent causes of serious accidents (involving pedestrians and serious injuries) included: hitting a pedestrian, side collisions, and head-on collisions; serious accidents happened most often on national roads, junctions, at nighttime, at pedestrian crossings and involved speed and hard roadsides (Fig. 3).

Road safety research in Poland (Jamroz et al. 2017, 2019) shows that:

**Table 1** Changes in Poland's road safety from 1988 to 2019 compared to socioeconomic changes

| | Population | Number of vehicles | Vehicle travel distance | Gross domestic product per capita | Number of fatalities | Road fatality rate | | |
|---|---|---|---|---|---|---|---|---|
| Year | P (m) | V (m) | VKT (b vkm) | GDPPC (thous. ID/year) | F (victims) | $RFR_P$ (victims/ 1 m. inhab.) | $RFR_M$ (victims/ 1 m. veh.) | $RFR_T$ (victims/ 1 b. vkm) |
| 1988 | 37.8 | 6.9 | | 8.20 | 4851 | 128.3 | 703.0 | |
| 1991 | 38.2 | 8.6 | 94.6 | 7.57 | 7901 | 206.8 | 918.7 | 83.5 |
| 1997 | 38.6 | 12.3 | 127.4 | 10.22 | 7312 | 189.4 | 594.5 | 57.4 |
| 2001 | 38.2 | 14.7 | 148.4 | 11.96 | 5534 | 144.9 | 376.5 | 37.3 |
| 2007 | 38.1 | 19.5 | 220.8 | 15.66 | 5583 | 146.5 | 286.3 | 25.3 |
| 2015 | 38.0 | 27.4 | 315 | 21.77 | 2938 | 77.3 | 107.2 | 9.3 |
| 2019 | 38.3 | 29.5 | 335 | 25.72 | 2909 | 75.9 | 98.6 | 8.7 |

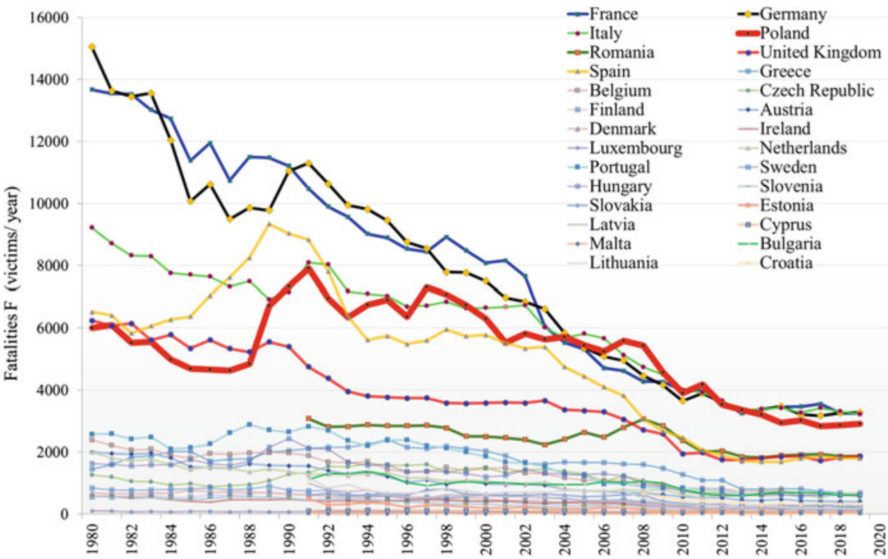



**Fig. 1** Changes in fatalities in EU countries in the years 1990–2018

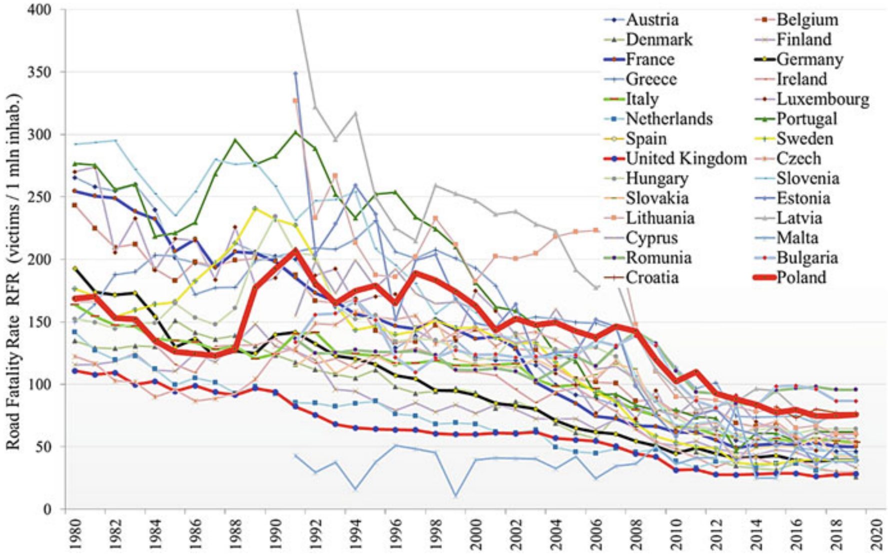



**Fig. 2** Changes in road fatality rates in EU countries in the years 1990–2018

1. Vulnerable road users: pedestrians, cyclists, and young drivers continue to be at high risk of death or serious injury.
2. Poland's basic road safety problems are still the same, i.e., poor quality of some of the road infrastructure, ineffective speed management, relatively poor road safety behavior.

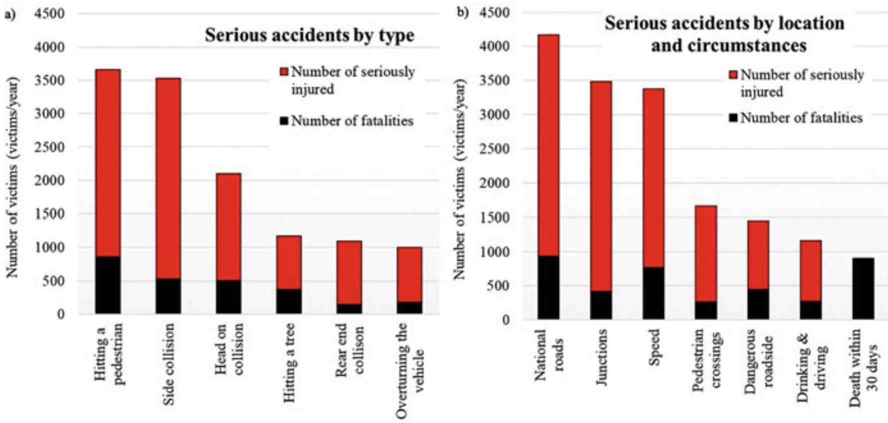



**Fig. 3** Distribution of fatalities and serious injuries in Poland's serious accidents broken by type (**a**) and accident location and circumstances (**b**)

3. Simple road safety measures are no longer working and soft measures are not enough; what is needed is an integrated and knowledge- and research-based approach with the right resources and funds.
4. The road safety management system is weak: there is no lead at the central or regional level, programs are poorly funded, access to accident databases is poor, and the scope of data is limited.

## Key Road Safety Problems

An analysis of Poland's road safety data has helped to identify nine problems which generate a particularly high number of road accident deaths. The road accidents in question occur on national roads and involve pedestrians, speeding, nighttime, running-off-the-road and hitting a tree, high severity (death at the scene or within 30 days), drink-driving, and accidents at junctions and pedestrian crossings. Despite a significant drop in fatalities in the last 20 years (1999–2019) (Fig. 4), fatal accidents remain a serious risk.

**Speed** Excessive, dangerous, or not adequate for the driving conditions, speed is the risk factor of about 30% of fatal accidents. Between 1999 and 2019 fatalities in these accidents fell by 61%. This is mainly thanks to the speed camera system (CANARD) (Jamroz and Michalski 2005; Jamroz et al. 2005), building a network of safe roads and introducing traffic calming zones in urban areas (Gaca and Kiec 2016). Sadly, other decisions were also made which went against fatality reduction in speed-related accidents such as reducing the coverage of the speed camera system (2015) and increasing motorway speed limits from 130 km/h to 140 km/h (2010).

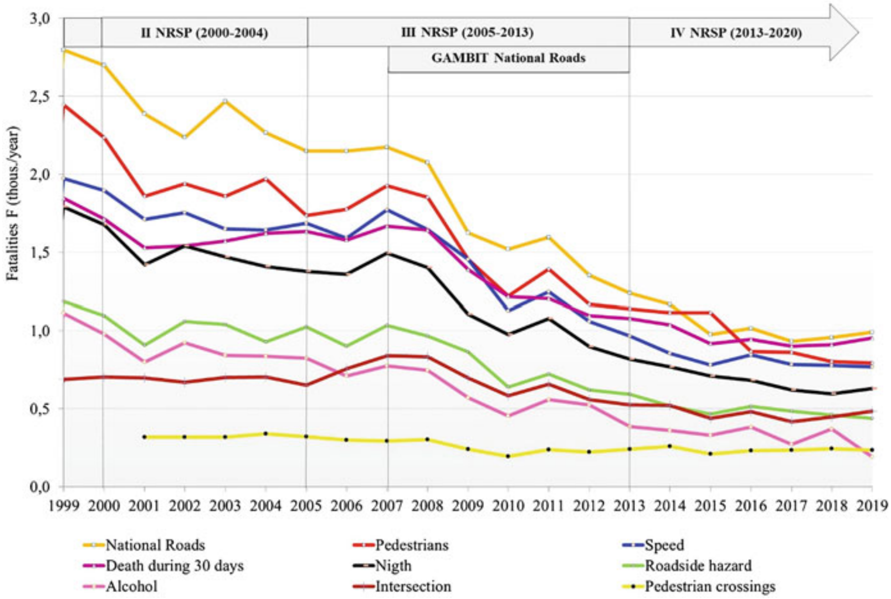



**Fig. 4** Changes in the number of road fatalities in Poland in the years 1999–2019 and in the periods of National Road Safety Programs (NRSP), broken by selected road safety problems

**National Roads** (managed by National Road Administration) carry more than 25% of overall traffic. Nineteen percent of all accidents happen on these roads with fatalities representing as much as 33% of all road deaths. The years 1999–2019 saw the introduction of a number of systemic policies such as the development and implementation of GAMBIT National Roads (Jamroz et al. 2008), construction of new motorways and expressways (between 2002 and 2019 nearly 3500 km of new sections were completed), and a steady improvement of safety standards. As a result, fatalities on national roads dropped by 65%. Certain problems, however, persist: too few good quality roads (motorways and expressways), lack of ring roads, roads with wrong cross-sections, underdeveloped and unsafe roadsides, lack of protection for vulnerable road users, road safety standards not met during road improvement works, and poor progress on ITS delivery for road traffic management.

**Pedestrians** For many years Poland has been one of the European Union's most dangerous countries for this (31% of all fatalities) with the highest number of pedestrian fatalities among EU countries. Between 1999 and 2019, pedestrian fatalities fell by 68%. The reduction has been particularly strong since 2007. Eighty-five percent of pedestrians are killed in built-up areas and 15% in non-built-up areas. The following are sites of fatal pedestrian accidents:

– Built-up areas: 48% at pedestrian crossings, 42% on the road, and 3% on the pavement

– Non-built-up areas: 87% on the road, 8% at pedestrian crossings, and 2% on the roadside
– National roads: 11%, regional roads: 17%, municipal and county roads: 29%, and county capital streets: 43%.

The main problems regarding pedestrian safety include: unregulated pedestrian priority on the road (work is under way to change the law), lack of pedestrian safety devices (pavements, refuge islands, traffic control devices on multilane carriageways), pedestrians poorly visible during nighttime, and drivers' behavior (excessive speed, not giving priority to pedestrians) (Jamroz et al. 2016, 2019). There are measures designed to improve pedestrian safety. These include: pedestrian and cycling paths being built along rural sections of national and regional roads and the Manual for organizing pedestrian traffic (Jamroz et al. 2014a), now the basis for improving standards of pedestrian infrastructure safety, especially at the local level. The aforementioned problems of pedestrian safety are also indicated in the new Polish guidelines for the design of pedestrian devices, which is under preparation.

**Death Within 30 days** Between 1999 and 2019 the number of people dying within 30 days from accident date fell by 48%. This is the result of elimination of hard obstacles in the roadside, using protective devices (i.e., road barriers), changing the car park (i.e., airbags as standard car equipment), and developing a rescue system. Nonetheless, high accident severity is still an important problem in Poland. The factors contributing to high accident severity (10 fatalities per 100 accidents) include: high vehicle speed on roads with unsegregated directions of traffic and hard roadsides, rescue system deficiencies, and problems of the health care system. Efforts must be taken to reduce accident severity by improving infrastructure, organization, and management, and implementing a better road rescue system and post-accident help for victims.

**Nighttime** Between 1999 and 2019 the number of fatalities in nighttime accidents fell by 65%. The factors contributing to nighttime fatalities include: higher speed during the night in built-up areas (60 km/h 24.00 to 6.00), limited perception of the road by road users on rural roads (pedestrians, drivers), vertical and horizontal markings not meeting reflectivity requirements, and poor lighting (in particular junctions, pedestrian crossings). It is common practice to switch off traffic lights at night. A contributing factor which is frequently underestimated, especially on motorways, expressways, and other transit roads is driver fatigue or driver drowsiness and a poor network of places where drivers can rest (Jamroz and Smolarek 2013a).

**Dangerous (hard) Roadside** About 25% of rural accidents and nearly 16% of all of Poland's fatalities involve vehicles running off the road which roll over or hit a roadside object. Between 1999 and 2019 the number of fatalities when a vehicle hit a hard roadside went down by only 63%. The main cause of the situation is that roadside design and maintenance are not adequately regulated. In addition, conflicts arise when roadside trees are to be cut down (another area without proper regulation). Steps are taken, however, to improve roadside safety such as tree felling when roads are built or improved, when new road sections are built running parallel to sections with protected tree lines, containment structures are used together with a new approach to safety barriers.

**Drinking and Driving** In the late 1990s, alcohol was one of Poland's main road safety problems. Between 1999 and 2019 the share of fatalities in drink-driving accidents dropped from 22% to 10% and fatalities in drink-driving accidents fell by as much as 83%. Poland has one of the lowest share of drink-driving fatality accidents, a result of intense and systematic enforcement (Police, Road Transport Inspectorate), education, awareness raising, and a change of alcohol consumption culture in Poland.

**Junctions** The primary problem of junctions has to do with the road infrastructure and increasing traffic. With a high number of simple junctions giving priority to the main road traffic and a growing demand for entry from side streets, drivers force their way across the junction causing more and more serious side crashes and head-on collisions. If fatalities are to go down, safer junctions should be used (roundabouts, signalized junctions), with better visibility, clarity, and easier to cross. In 1999 the share of fatalities in accidents at junctions compared to all fatalities was about 10% to increase in 2018 to 14%. Fatalities within this period went down by 30%. More efforts must be taken, in particular building modern and safe junctions, to eliminate side crashes and head-on collisions. Equally, more needs to be done to improve enforcement (speed control and running the red light), compliance, and partnership among drivers).

**Pedestrian crossings** Crossing the road is one of the highest risk behaviors of road users in Poland. Pedestrian accidents usually happen on the road 60%, at pedestrian crossings 30%, and on pavements 4%. Crossing a road in Poland carries a lot of risk. The problems pedestrians face include a lack of pedestrian protection on high speed roads (lack of elevated refuge islands, ineffective protection at painted refuge islands, lack of cycle crossings, etc.) and extended pedestrian crossings, which are particularly dangerous when pedestrians have to cross four or six lanes that are not separated and sometimes even include tram tracks in the middle. The share of pedestrian fatalities in road accidents is 5–8% of all fatalities and has been at 250 annually over the years. If pedestrian fatalities at pedestrian crossings are to fall, the number, location, and type of pedestrian crossings must be verified; pedestrians should spend less time in vehicle conflict zones, conflicts between pedestrians and vehicles should be minimized and, once the conflict happens, the consequences should be minimized thanks to lower speeds in pedestrian zones.

## Poland's Road Safety Programs

### General Characteristics of Road Safety Programs

Poland's experience of road safety policies is relatively short. Following GAMBIT 96, there have been five national road safety programs (Table 2) of which the first four are called GAMBIT and were developed by teams headed by the Gdansk University of Technology.

**Table 2** National road safety programs in Poland between 1996 and 2020

| Program (years in force) | Acronym | Policy/ vision | Strategies | Actions | Responsible entity |
|---|---|---|---|---|---|
| Integrated road safety Program GAMBIT'96 (1996–1999) | I NRSP* | None | Main qualitative goal, overall fatality reduction | Grouped (integrated) | National Road Safety Council |
| Road Safety Program for Poland 2001–2010 GAMBIT 2000 (2000–2004) | II NRSP | None | Main target (4000 fatalities in 2010), 2 objectives | Two groups of tasks | National Road Safety Council |
| National Road Safety Program 2005–2007 – 2013 GAMBIT 2005 (2005–2013) | III NRSP | Vision zero | Main target (2800 fatalities in 2013), 5 strategic objectives, operational program | 4E** and system development | Secretary of the National Road Safety Council |
| Road Safety Program 2007–2013 GAMBIT National Roads (2007–2013) | GAMBIT National Roads | Vision zero | Main target (500 fatalities on national roads in 2013); priorities, pilot program | 3 eras, 4E | National Roads Administration |
| National Road Safety Program until 2020 (2013–2020) | IV NRSP | Vision zero | Main targets (2000 fatalities and 6900 serious injuries in 2020), 5 pillars | Safe system, 4E | Secretary of the National Road Safety Council |

[a]NRSP – National Road Safety Program
[b]The 4 E's concept includes: Education, Engineering, Enforcement, Emergency

## Detailed Characteristics of Road Safety Programs

### Integrated Road Safety Program GAMBIT 1996 (I NRSP)

Commissioned by the Minister of Transport and Maritime Economy, Poland's first comprehensive Integrated Road Safety Program was developed between 1993 and 1996, known as GAMBIT 1996. Authored by a multidisciplinary team made up of scientists, engineers, teachers, police officers, fire fighters, and experts in many fields, the program was led by the Gdansk University of Technology (Krystek et al. 1996). Its biggest strength was that it brought together different sectors and industries around a common goal. With multiple specialists forming a single multidisciplinary team, work on the program paved the way for long-term cooperation of the different communities and helped to build the foundations for Poland's systemic policies. GAMBIT'96 was Poland's first ever integration and coming together of the sectors of education, infrastructure, enforcement, and rescue. The knowledge and experience of many foreign experts (Muhlrad 1991; Laberge-Nadeau et al. 1992; Haegi 1993; Gunnarsson 1995) helped to develop the program.

A diagnosis helped to identify the biggest problems: lack of road safety bodies, dangerous road infrastructure, high share of old vehicles in vehicle streams, and ineffective enforcement. In 1995, road accidents on Polish roads claimed the lives of 6900 people. The program did not set a target and instead gave a general goal of reducing road accident fatalities in Poland.

While GAMBIT 1996 was commissioned by central authorities, central government did practically nothing to implement the Program and seemed satisfied with just having a program and carrying out the odd ad hoc measure completely unrelated to the Program's methodology. Building on the national program, several regional programs were also developed (Gdansk, Elbląg, Katowice, Suwałki) and systematically implemented. The regional level became involved in improving road safety (Michalski et al. 1998).

Unfortunately, following the country's administrative reform (the number of regions went down from 49 to 16 and a four tier structure was established), regional efforts came to a halt in 1999.

The program's scientific outcome was the first International Road Safety Seminar GAMBIT (GAMBIT 1996), which brought together scientists, practitioners, administration, and NGOs. Since then the Gdansk University of Technology has been hosting biennial meetings of scientists from institutes and universities, engineers, producers of road safety devices, teachers, police officers, road rescue staff, doctors, and lawyers interested in protecting road users from the risk of injury or death (Fig. 5). They exchange experience, set new directions, and put pressure on central, regional, and local authorities.

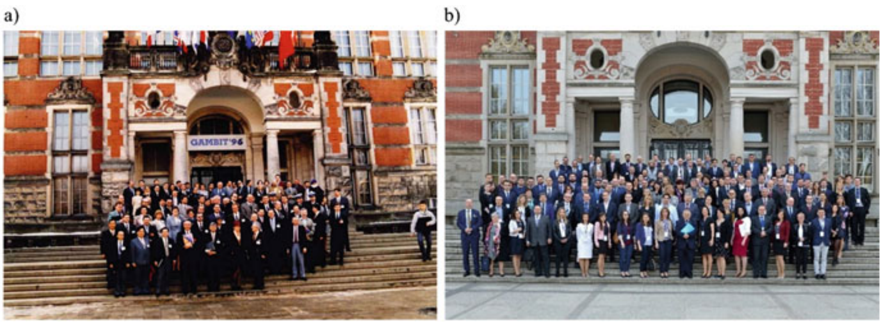



**Fig. 5** Participants of the Road Safety Seminar GAMBIT in front of the Gdańsk University of Technology main building: (**a**) GAMBIT'96, (**b**) GAMBIT 2018

### Poland's Road Safety Program for the Years 2001–2010 GAMBIT 2000 (II NRSP)

In 1999, a new administrative structure emerged with four tiers of governance: central, regional, county, and municipal. As a consequence, Poland's road network structure changed as well and the transport minister commissioned a new road safety program, which was called GAMBIT 2000 (Krystek et al. 2001).

In 2000, road accidents on Polish roads killed 6294 people. A diagnosis was carried out and identified the main problems: excessive speed, vulnerable road users, accident severity, transit roads passing through small towns, and high risk sites.

Taking advantage of international experience (OECD 1994; Andersson and Nilsson 1997; Broughton et al. 2000; Kroj 2001; Oppe 2001) and based on analyses of socioeconomic forecasts, GAMBIT 2000 adopted strategic goals. The main goal was to reduce road accident fatalities to 4000 in 2010 (i.e., to reduce fatalities by 36% compared to 2000). There were three objectives:

1. Implement road safety measures in seven problem areas
2. Create a basis for an effective and long-term road safety policy
3. Gain public support for road safety

The program also identified two groups of tasks:

1. Systemic action (group A) to include safety management, building databases and knowledge, safety audit, and staff training. This was designed to make road safety management more efficient following a review of the laws and adding new regulations to help with an effective delivery of the program.
2. Action to include the main problems and threats (group B) such as excessive speed, vulnerable road users, accident severity, transit roads passing through small towns, high risk sites to an extent compatible with the diagnosis and availability of funding. The program had its first short-term and long-term targets.

GAMBIT 2000 was formally adopted by the government in May 2001 as the National Road Safety Program until 2010. It was designed as the government's road safety program using direct or indirect means to change road user behavior and road safety management by the regions, counties, and municipalities. The Program was to help local authorities to create better conditions for effective road safety policies. The Program's funds were to be spent on building or improving road infrastructure. The work was considered a pilot to promote "good practice" in the area of road safety treatments (Krystek et al. 2001).

In the initial period of GAMBIT 2000 (a period of 2.5 years), fatalities compared to 2000 dropped by 10.4%. While work on delivering goal 1 (specific measures) and goal 2 (systemic measures) progressed, goal three, i.e., to gain public support for road safety never took off.

Despite the short period, GAMBIT 2000 helped to:

- Increase activity at the regional and local level (training for road safety staff, developing regional and local road safety programs, increase in using effective road safety measures)
- Build and implement systems for monitoring selected road user behaviors (speed, seatbelts) in all regions
- Prepare road safety training for central and regional staff
- Support financially central (national roads, police, rescue) and regional work (regional and county roads)
- Raise public awareness of road traffic risks
- Involve nongovernmental organizations in road safety efforts

The possible reasons why GAMBIT 2000 goals were not achieved in their entirety might be that the program did not really have a clear leader to run it and be accountable for it. Poor cooperation between central and local government was also to blame (especially between different tiers of road authorities). There was too little engagement from central bodies because decision-makers just did not think road safety was a strong enough priority. Shortage of staff and lack of scientific and technical support for road safety professionals also contributed to the poor performance. On the practical side, there were no operational programs to translate the plans into tasks and projects with specific targets, monitoring indicators, costs of delivery and contractors, all of which may have significantly boosted planning and availability of funding. With Poland lagging behind the safety standards required by the European Union in the run-up to becoming a member, a new approach to road safety was definitely called for (GAMBIT 2002).

### National Road Safety Program for the Years 2005–2007–2013 GAMBIT 2005 (III NRSP)

When Poland joined the European Union in 2004, the country was required to adapt its national road safety program to the new conditions under the EU's transport policy, its strategy set out in the White Paper and the third EU Road Safety Action Program. The program aimed to halve the number of road deaths between 2000 and 2010 (European Commision 2000). The National Program GAMBIT 2005 was planned for the years 2005–2013, fitting in with Poland's first financial support period from the European Union (Jamroz et al. 2005).

In 2003, stage one of GAMBIT 2000 ended providing a baseline for GAMBIT 2005. Poland's basic road safety indicators were: 5740 people killed, 147 people killed per one million population. The rates were at a 1970s level of Sweden, the Netherlands, and England and were almost double the rates recorded in those countries at that time. Poland's basic road safety problems included: dangerous road user behavior; insufficient protection of pedestrians, children, and cyclists; poor quality of road infrastructure; and ineffective system of road safety.

While the authors analyzed the visions of a number of countries (12 original visions) (OECD 2002), the one they felt strongest about was Vision Zero delivered in

Sweden (Tingvall 1998; Tingvall and Haworth 1999), and also in Norway (Siegrist 2010), Iceland (Sigţórsson et al. 2013), Australia (Wadhwa 2001), and Switzerland (Siegrist 2010).

The new program set its strategic target at halving fatalities by 2013 compared to 2003 numbers, which meant not more than 2800 people killed in road accidents in 2013 (Fig. 6a). The program defined three time perspectives:

1. A far-reaching vision of road safety based on Vision Zero
2. A road safety strategy until 2013 (approved by the Polish government in 2005) and a strategic goal for the next period 2014–2020
3. An operational program for the years 2005–2007 (approved by Poland's new government in 2006, sadly without earmarked funding)

To achieve the quantitative goals, five strategic goals were formulated:

1. Prepare a basis for effective and long-term road safety action
2. Shape safe road user behavior
3. Protect pedestrians, children, and cyclists
4. Ensure a safe road and roadside infrastructure
5. Reduce accident severity and accident consequences

Each strategic goal set out strategic actions and tasks. There were 144 tasks in 16 strategic actions. The program adopted an extended 4E principle. It aimed to build a road safety system and improve the organizational structures, education,

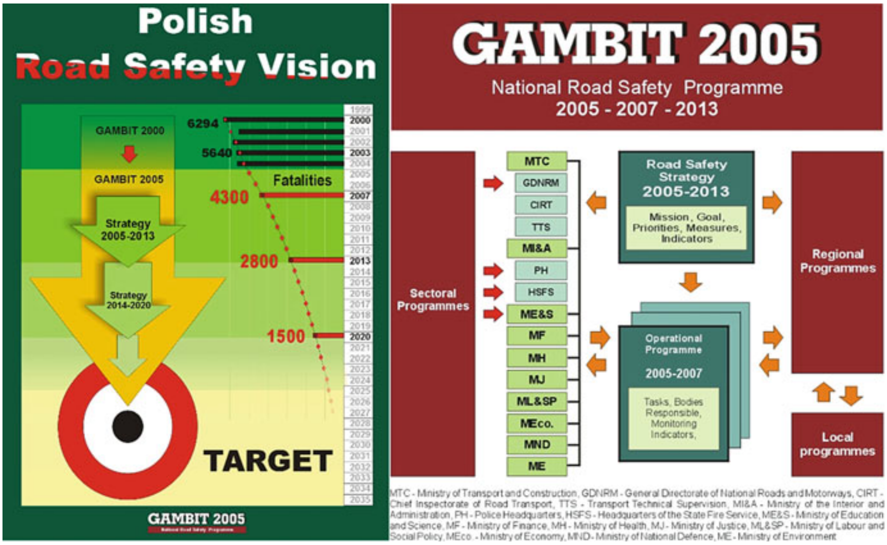



**Fig. 6** National Road Safety Program for the Years 2005–2007–2013

enforcement, road infrastructure, and road rescue (GAMBIT 2006). The five areas were to be integrated at three tiers: national (ministries, administration, and central institutions), regional (regions), and local (county, city) (Fig. 6b).

GAMBIT 2005: (**a**) Polish Vision Zero, (**b**) the program's delivery structure.

As part of GAMBIT 2005 implementation, there were a number of national level activities in areas such as education, prevention, and infrastructure providing a great fit with the overall program directions. Despite that, a number of political and administrative decisions were taken which went against the program. Quite a lot was done in the area of legislation, education, prevention, and infrastructure. In the first 5 years into the Program, 84 of 144 tasks (58%) were launched. While some did not bring the expected results or were poorly performed, others worked well and helped to improve road safety. They included:

– Regional and county road safety programs were developed and implemented covering a dozen regions, cities, and counties
– Sectoral road safety programs were developed and implemented (for national roads, police programs)
– Work began on building the Polish Road Safety Observatory and two regional observatories
– Driver training and exams were changed
– An enforcement system was implemented and developed (speed control, driver working time control)
– Cycling was regulated
– A network of expressways and motorways was extended, safe junctions and traffic calming measures were built
– Road safety audit was made compulsory for some projects
– Rescue and post-accident protection systems were modernized

Unfortunately, many of the Program's important steps were never taken such as:

– GAMBIT 2005 did not have a clear leader.
– The structures of road safety bodies were not improved or made more efficient, especially the National Road Safety Council.
– No local institutions were appointed (inspectors, officers, leaders).
– No system of sustainable road safety funding was introduced.
– No monitoring system was built to keep track of strategy progress.
– Effective road safety measures were not promoted.

Evaluation of the first short-time operational program was conducted in 2007. It concluded that (Wegman 2007):

1. The road safety strategy and action plans under GAMBIT 2005 were well prepared.
2. Road safety staff were trained, increasing the number of road safety professionals at different levels of governance. Polish experts benefitted from training available

abroad (the Netherlands, France, and Sweden) and are well-informed participants of the international road safety community.
3. The actions set out in GAMBIT 2005 were not delivered fully or evaluated for their effectiveness. Funding was limited. As a result, the impacts were limited, too.
4. While regional GAMBIT programs were quite abundant and well prepared, delivery was poor and ineffective with no support from the central level, lack of solid accident databases, or a systematic evaluation of the programs.
5. The lead agencies within government structures (leaders) with responsibility for road safety did not emphasize a strong enough political will to improve road safety (lack of a political or operational leader and agencies not happy to work together).

The analyses show that Poland's approach to the problem was far from the standards normally applied in the European Union. It was clear that when the next national program is formed, the institutional setup would have to be given top priority to ensure that the program can be delivered effectively.

#### Road Safety Program for the Years 2007–2013 – GAMBIT National Roads

In 2007, a sectoral program was developed to address the network of national roads, called GAMBIT National Roads (Jamroz et al. 2008). For the first time the National Roads Administration acknowledged the role of partners (teachers, journalists, police officers, and fire fighters) in delivering a joint road safety vision. This was the basis for an integrated effort in a 4E approach. The program's mission followed a slogan used by many countries: **Safe roads save lives**. The program was a delivery mechanism for the National GAMBIT 2005 Program and its national roads infrastructure section. With a fairly high amount of EU funding available for road infrastructure, the main goal was defined very ambitiously, i.e., to reduce road deaths between 2006 and 2013 on national roads managed by the General Directorate for National Roads and Motorways by 75%, i.e., 500 fatalities in 2013 (Fig. 7).

Six special goals were set to reduce fatalities which are the result of: hitting a pedestrian, head-on collisions, side and rear crashes, running off the road, to reduce

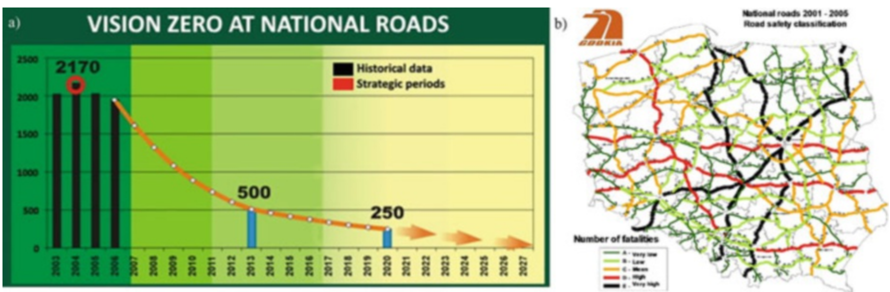



**Fig. 7** GAMBIT National Roads: a) Vision Zero on national roads, b) Classification of road safety on Poland's national roads 2001–2005

nighttime fatalities, and fatalities caused by excessive speed. The tasks were organized into three groups following the 3Eras concept (infrastructure measures, safety management, and development of safety culture). Designed to ensure effectiveness and efficiency, the selection procedure consisted of the following steps (GAMBIT 2008):

1. Select sections with the highest risk of serious accidents
2. Identify hazards on high or very high risk sections (based on road safety inspection or audit)
3. Select the most effective action

The procedure made a difference in that it focused on comprehensive actions to include the following pillars: engineering, enforcement (speed cameras), emergency, education (campaigns in schools in close proximity to the roads), and the media (cooperation with national, regional, and local media) within the corridor of national road no. 8 (Fig. 8). When the road was modernized, fatalities on that road dropped by about 30%. The best solutions were implemented on another set of eight roads and then rolled out on 88 national roads; this time, however, only engineering measures were applied. Unfortunately, despite the positive outcomes of the pilot project the strategic goal was not achieved because in 2013 more than 1200 people were killed (against the goal of 500 fatalities in 2013 – Fig. 7a) on national roads which means that the assumptions were overly optimistic. More work followed in the next period. Mainly designed to build motorways and expressways, the actions helped to reduce fatalities on national roads below 1000 road deaths, but they also helped to reduce fatalities on non-national roads (secondary roads). This was possible thanks to traffic shifting from lower standard roads to better standard roads.

### National Road Safety Program until 2020 – NRSP 2020 (IV NRSP)

In 2012 (a year before the previous program ended) work began on drafting a new program called the National Road Safety Program 2013–2020 (National Road Safety Council 2013). Detailed analyses showed that the main factors contributing to accidents in Poland are still the same:

– The State’s organizational and functional system (lack of political will, lack of a road safety body)
– Dangerous road user behavior (excessive speed, willingness to take risks, drivers not treating pedestrians and cyclists properly)
– Too few devices for pedestrian and cyclist safety
– The road safety management system (lack of a speed management system, lack of tools for managing road infrastructure safety)
– Quantity and quality of road infrastructure (lack of a network of high safety standard roads, few safe junctions)
– Deficiencies in the operation of the rescue and post-accident help systems

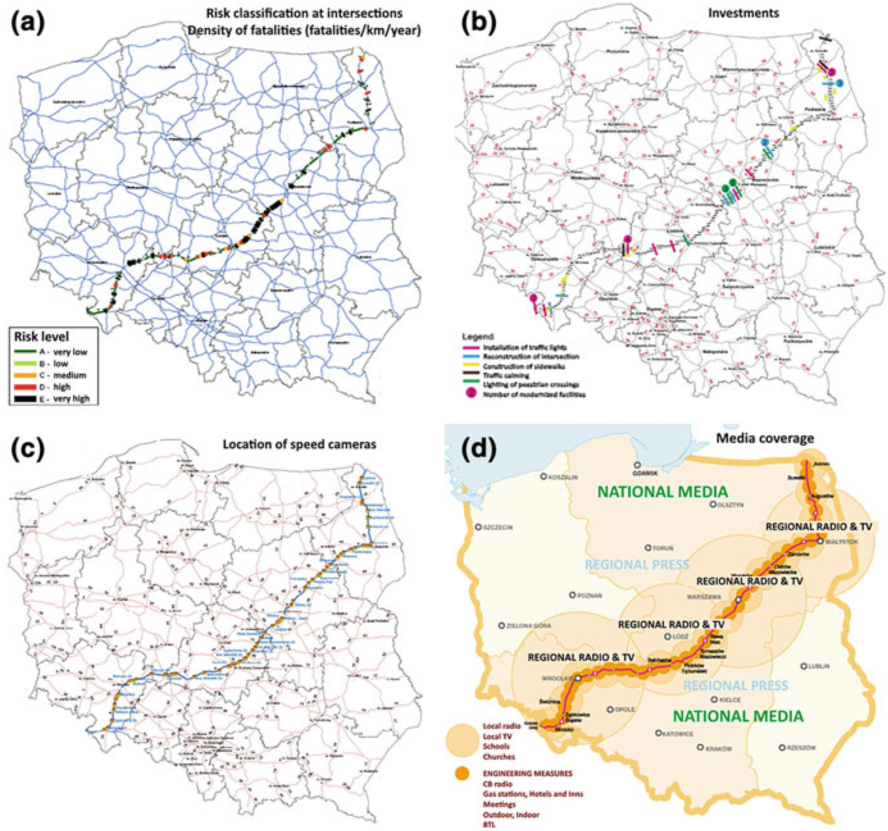



**Fig. 8** Pilot project 8 + 8 + 88, national road no. 8: (**a**) risk classification on road sections, (**b**) location of proposed engineering treatments, (**c**) location of speed cameras, (**d**) coverage of regional and local media which cooperated in the pilot project

The Program builds on the assumptions of Vision Zero adopted in the previous road safety programs. It has two main strategic goals: to halve fatalities on Polish roads, i.e., to reach 2000 and to reduce serious injuries by 40%, i.e., down to 6900 in 2020 compared to 2010. Developed on the basis of the Safe System (OECD 2008; Larsson et al. 2010; Groeger 2011; Mooren et al. 2011), the Program has five pillars of action: safe people, safe roads, safe speed, safe vehicles, medical rescue and post-accident care (in accordance with the suggestions of the UN Decade). Each pillar sets out priority actions which represent Poland's basic road safety problems and how they should be tackled. Each priority is a set of measures in the areas of engineering – understood as technical measures, enforcement – understood as enforcement and control, education – understood as raising road safety awareness by understanding the risks. In addition, the Program included a section on rescue measures (4E's). While the program received the endorsement of the National Road Safety Council, it did not win the approval of the Polish government leaving it without any political or financial support. The Program is delivered by the Secretariat of the National Road Safety Council which prepares annual implementation programs made up of measures that can be delivered by central bodies using their own resources (road administration, police, fire service) and national measures such as training, studying road user behavior, media campaigns, development of road safety device design, and examples of good practice. The effects, however, are not satisfactory with cheap road safety measures no longer achieving much improvement or effect.

## Role of Research

One of the main pillars of Vision Zero is facts and research in place of myths and just scratching the surface of the problem. As work on developing and implementing national and regional road safety programs began, it was clear that there is a lack of knowledge about the factors that affect road safety and a lack of tools. The available science did not include:

– An understanding of dangerous road behavior
– An understanding of the most relevant human, technical, and organizational factors and how much they affect the risks of road accidents on Poland's roads
– Methods to classify road sections for their safety
– Methods for long-term forecasts of fatalities nationally and regionally
– Methods for assessing the effectiveness and methods for selecting effective road safety treatments
– Methods for monitoring progress of treatments

Research was an important part of the implementation of the individual road safety programs. Some of it was conducted by university and research institute staff and some under national and international research grants (Jamroz et al. 2010; Jamroz 2011; Bergel-Hayat and Żukowska 2015; Gaca and Kiec 2016).

One of the first research areas was a nationwide study of road behavior carried out between 2002 and 2007 (Jamroz et al. 2016; Gaca and Kiec 2016) and continued in the periods that followed (Jamroz 2013). The first results were shocking:

– Nearly 50% of drivers drove over the speed limit with as much as 90% of drivers speeding on transit roads passing through villages and towns.
– Forty percent of drivers and front seat passengers and 60% of back seat passengers did not use seatbelts.

The results helped to intensify information and training campaigns and enforcement, including the start of building an automatic speed camera system called CANARD (Jamroz et al. 2005).

An important issue was building a Road Safety Observatory and developing a method for estimating road accident costs. Thanks to the method, it was possible to estimate Poland's annual costs of road accidents reaching more than 10 billion euro.

The next research area designed to support road safety was a study of risk-based methods for estimating fatalities and classifying road sections for accident risk (Jamroz 2011). This work helped to develop a concept of how Poland's road safety will change as a result of treatments (Jamroz et al. 2010; Jamroz and Smolarek 2013b; Wachnicka 2018). According to this concept, a country's level of road safety depends primarily on its level of socioeconomic development and population mobility. If we consider that the road fatality rate (RFR) is a normalized measure of the country's road mortality, the level of road safety changes nonlinearly depending on changes in socioeconomic development (Fig. 9).

Within the range of low and very low socioeconomic development, as people's incomes grow, so does their mobility as well as motorization and density of paved roads. Because road and vehicle standards are low, road accident fatalities increase quickly.

As gross domestic product GDP continues to grow, the rate of increase in fatalities levels off and the RFR reaches a breakpoint. This is the result of a shock when people realize the death toll of road accidents and start to think twice as drivers and pedestrians leading them to slowly change their behavior as road users (a decreasing appetite for risk: driving slower, commonly using seatbelts, no drinking and driving). National and local institutions and organizations take steps to reduce the pace of growing motorization, a safety system becomes operational (developing a system of legislation, education, appointing a leader), safety management methods are used (a more developed enforcement system, safety programs).

Once the increase in fatalities reaches its breakpoint, accident mortality drops rapidly, a situation caused by a more stable level of motorization, density of paved roads and population mobility, and more better quality roads, i.e., expressways and motorways. Key to this is also the development of state and democratic institutions

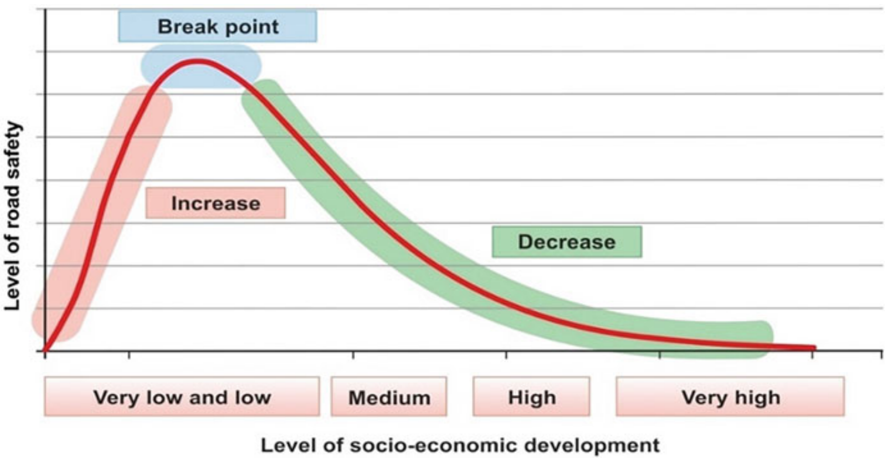



**Fig. 9** Concept of a model of road safety changes in a country depending on its level of socioeconomic development

leading to less corruption, a better health care system, safety culture (use of seat belts, lower alcohol consumption).

With a growing GDP and a very high level of socioeconomic development, the fatality rate should aim asymptotically to zero. This is helped by the fact that societies increase their wealth and have more respect for each other's lives including those of road users. Adopting this concept and explaining it to those who care about road safety was very helpful with understanding the mechanisms of how a road safety system operates. The concept was used to formulate the vision and strategies in the new road safety programs (Figs. 6a and 7a) and in the proposed method for forecasting fatalities (Jamroz and Smolarek 2013b).

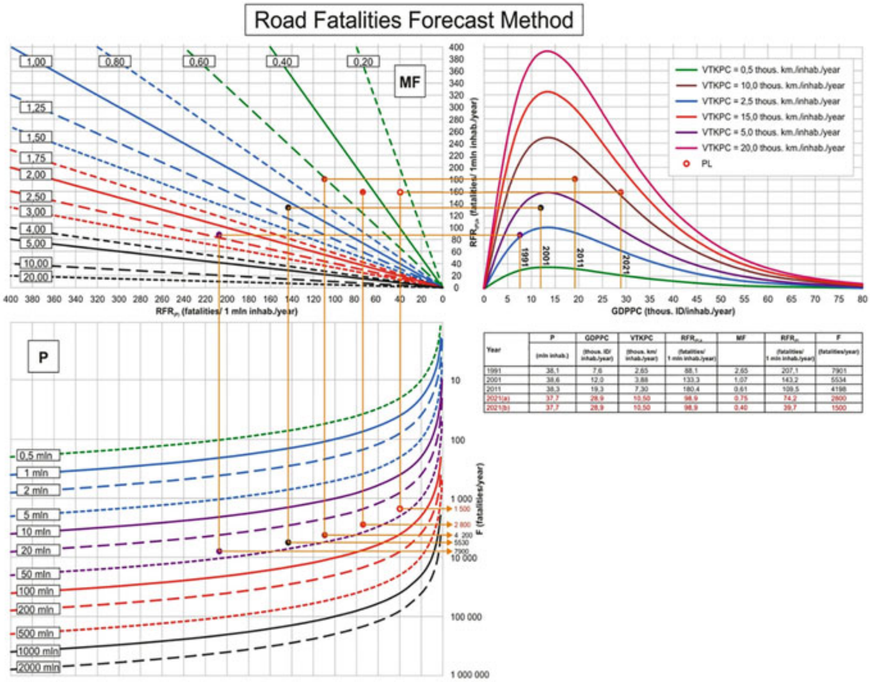
Poland did not have methods for forecasting road accident fatalities at the national or regional level. Attempts were made to use available methods and models (Smeed 1949) or the work of external experts (Oppe 2001). Simplified methods were also used. But because they were international methods, they did not account for Polish conditions or left out many important factors just as the simplified methods. As a result, the fatality forecasts were far from reality. Efforts were taken to develop Poland' own methods for forecasting road accident fatalities depending on demographic and economic factors at the national (Jamroz 2011) and regional levels (Wachnicka 2018).

To assess safety at the national level (strategic), the risk-based approach was applied which takes account of road traffic behavior of entire social groups in an area (country, region). Estimates are made of the consequences of road accidents (number of fatalities, accident costs) within a specific time period (usually over a year), which may occur as a result of dangerous incidents caused by a malfunctioning road transport system. Key to the level of the strategic risk are the country's economic development, level of motorization, social change, better education, etc.

The most commonly used measures of strategic risk are: number of fatalities F as a general measure and the road fatality rate dependent on demography RFR as a normalized measure for comparing countries for their safety levels.

A group of mathematical models was elaborated to estimate road accident fatalities F depending on gross domestic product per capita GDPPC, average number of kilometers traveled by car per capita VTKPC, number of population P, and a set of modifying factors MF (including: level of health care, level of education, level of corruption, density of road network, seat belt usage, alcohol consumption, etc.). The models were then used to develop a simplified and easy to use (by decision-makers, students, journalists) method for estimating measures of societal risk (RFR and F) shown in Fig. 10 (Jamroz and Smolarek 2013b).

A good example of how research can serve to solve road safety problems was a research program called Development of Road Innovation (RID) delivered between 2015 and 2019 by the National Centre for Research and Development and the General Directorate for National Roads and Motorways. Of the total of 15 research projects seven were dedicated to road safety problems such as: design and maintenance of safety barriers, 2 + 1 roads, the effect of advertising on road safety, speed management, the effect of ITS methods on road safety on motorways, and use of nonstandard road marking. The results of these projects are being incorporated into design practice (Gaca et al. 2018; Jamroz et al. 2018a; Oskarbski et al. 2018).




| Year | P | GDPPC | VTKPC | RFR | MF | RFR | F |
|---|---|---|---|---|---|---|---|
| | (mln inhab.) | (thous. ID/ inhab./year) | (thous. km/ inhab./year) | (fatalities/ 1 mln inhab./year) | | (fatalities/ 1 mln inhab./year) | (fatalities/year) |
| 1991 | 38,1 | 7,6 | 2,65 | 88,1 | 2,65 | 207,1 | 7901 |
| 2001 | 38,6 | 12,0 | 3,88 | 133,3 | 1,07 | 143,2 | 5534 |
| 2011 | 38,3 | 19,3 | 7,30 | 180,4 | 0,61 | 109,5 | 4198 |
| 2021(a) | 37,7 | 28,9 | 10,50 | 98,9 | 0,75 | 74,2 | 2800 |
| 2021(b) | 37,7 | 28,9 | 10,50 | 98,9 | 0,40 | 39,7 | 1500 |

**Fig. 10** Simplified method for estimating road accident fatalities F in the analyzed country

These are just some of the research projects that have helped to get a better understanding of the factors contributing to safety, develop methods for estimating accidents and casualties, and prepare tools for designing elements of roads and selecting effective and efficient solutions (GAMBIT 2016, 2018).

## Role of International Cooperation

Following the development and implementation of national, regional, and local road safety programs, and III NRSP (GAMBIT 2005), in particular, Poland has seen a systematic drop in road accident casualties. Polish experts have established a stronger international presence; substantial efforts have been made to improve road safety using tried and tested solutions from other countries. There was help from many experts (the Netherlands, Sweden, Germany, and Switzerland) with training for Polish experts, road authorities, road police, etc. As a result, Poland reached the breakpoint earlier than other countries marking the start of a downward trend in fatalities thanks to lessons learned from more advanced countries (Fig. 11). By using the experience of developed countries, developing countries respond to unfavorable trends earlier and take steps to improve their road safety management

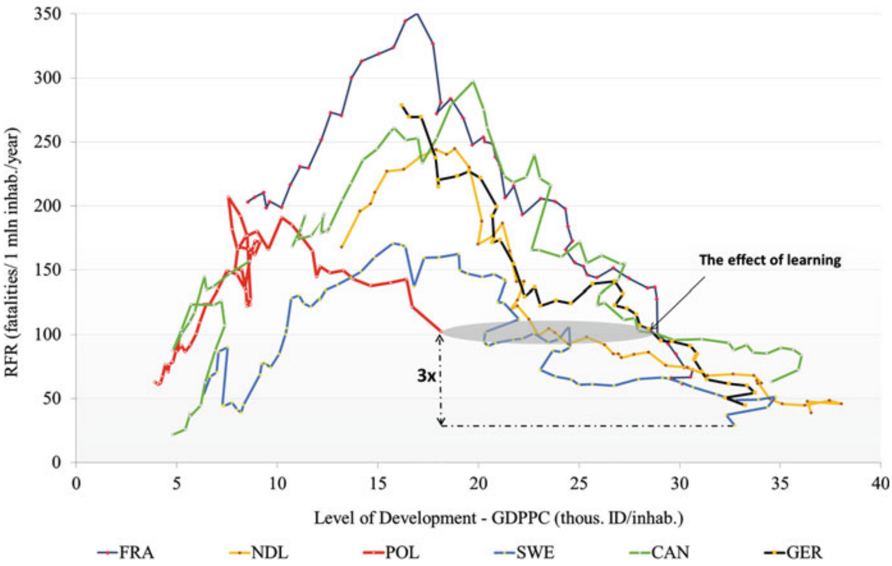



**Fig. 11** Concept of a model of how experience (effect of learning) influences a country's level of safety

systems, spend more on improving road safety, implement new solutions and regulations, and are able to reduce road transport fatality rates.

Poland has benefited greatly from EU accession in 2004. The effect has been positive because (Jamroz et al. 2018b):

(a) Polish road safety strategies and programs have had to adapt to EU transport strategies and road safety programs and their requirements.
(b) Rigorous norms and standards, including those for road infrastructure safety (European Parliament and the Council 2008) have been made part of Poland's legislation and design and maintenance practice for national roads and some of local roads.
(c) With access to EU funds, Poland was able to develop a safe and modern road infrastructure such as motorways and expressways, numerous ring roads, and new links.
(d) Road safety scientists and researchers have better access to international programs and research projects, research infrastructure, and modern technologies; they are part of international teams, research projects, and conferences.
(e) Member states put pressure through their annual rankings and reports on the progress they make in achieving the strategic goals set out in road safety programs.

Poland's road safety benefitted greatly when the country joined EuroRAP's risk assessment program in 2006 (EuroRAP 2018). Using methods developed by

EuroRAP, an assessment was conducted of the risk on national roads (Fig. 7b) and compared to the level of risk in other countries. With poor results, the road authorities felt motivated to improve road safety. EuroRAP's methodology was used as a basis for developing Poland's own methods for assessing and classifying risk on national and regional roads and on street networks in major cities (Jamroz 2019).

## Evaluation of the Effectiveness of Poland's Road Safety Programs

As the programs were ongoing, it was clear that road safety had improved significantly (Table 3). During GAMBIT96 the drop in fatalities was small at a mere 2.5%. During the subsequent programs, however, the effects were substantial; between 2000 and 2019 (GAMBIT 2000, GAMBIT 2005, NRSP 2020) the number of fatalities almost halved. The biggest reduction in fatalities was achieved during GAMBIT 2005; in that period (2005–2012) fatalities fell by nearly 40%.

Below are the characteristics of the most important efforts supported by the programs. Figure 11 shows how the efforts were positioned relative to the changes in fatalities in Poland between 1986 and 2018.

**Period Before Road Safety Programs (1986–1995)** Under planned economy (until 1989) the people of Poland had poor access to cars and fuel which was rationed (up to 30 liters per car per month toward the end of the period). As a result, population mobility was much lower and people prevalently used public transport to travel. The constraints meant that there were very few fatalities. The problem began when the political system changed (from socialism to democracy) and the economy went through a transformation (from planned to capitalist economy), which was in the second half of 1989. With the introduction of the free enterprise act, Polish citizens were able to buy cars freely (mostly second-hand cars bought abroad) causing a rapid increase in cars on Polish roads. Young drivers with very little

**Table 3** Changes in people killed during individual road safety programs in Poland between 1996 and 2019

| National road safety program | Program period | Population | No. of fatalities | Change in killed | Rate of change in killed | Percentage drop in killed | Road fatality rate |
|---|---|---|---|---|---|---|---|
| | | P (m) | F (victims) | DF (victims) | TF (victims/ year) | PF (%) | RFR (victims/ 1 m pop.) |
| – | 1995 | 38.6 | 6900 | – | – | – | 178.8 |
| I NRSP | 1996–1999 | 38.7 | 6730 | −170 | −43 | −2.5 | 173.9 |
| II NRSP | 2000–2004 | 38.2 | 5712 | −1018 | −204 | −15.1 | 149.5 |
| III NRSP | 2005–2012 | 38.1 | 3540 | −2172 | −272 | −38.0 | 92.9 |
| IV NRSP | 2012–2019[a] | 38.3 | 2909 | −631 | −90 | −17.8 | 76.0 |

[a]currently in force

experience of driving more powerful and dynamic cars and practically no police on the roads (change of structure, staff, and forms of operation) produced an “explosive mix” with tragic consequences and an increase in fatalities at 3050 in 2 years (from 4851 in 1998 to 7901 killed in 1991), i.e., by 63%. This came as a real shock to both government and society.

In 1992, the World Bank experts were employed to study the situation. Their report identified Poland’s main road safety problems such as lack of an organization with responsibility for road safety and a very high risk to road users in Poland (Gerondeau 1993). A combination of a shocked public, refusal to accept the high road traffic risk, pressure from the media, and fast economic growth helped to overcome the trend. Following the critical peak of 1991 and the World Bank report results, Poland took steps to develop its road safety program. In 1995 there were 6900 fatalities on Polish roads (i.e., a reduction of 1000 compared to 1991) (Fig. 12).

**1996–1999** A time of strong variations in the fatality trends between 1993 and 1997 as the central government made other issues its priority. Despite that, fatalities dropped significantly after 1997, a trend which continued until 2001. Because the program only lasted for a short time, it achieved a mere 2.5% drop in fatalities at 6730 victims (i.e., 170 victims less compared to 1995). With the adoption of the Road Traffic Act (1997), road traffic and enforcement were better regulated and improved. In 1999, the Act was amended to add a drinking and driving regulation making a BAC above 0.05% a crime as opposed to a misdemeanor which it was before. That was a very good start to more measures designed to reduce accidents caused by drunk drivers.

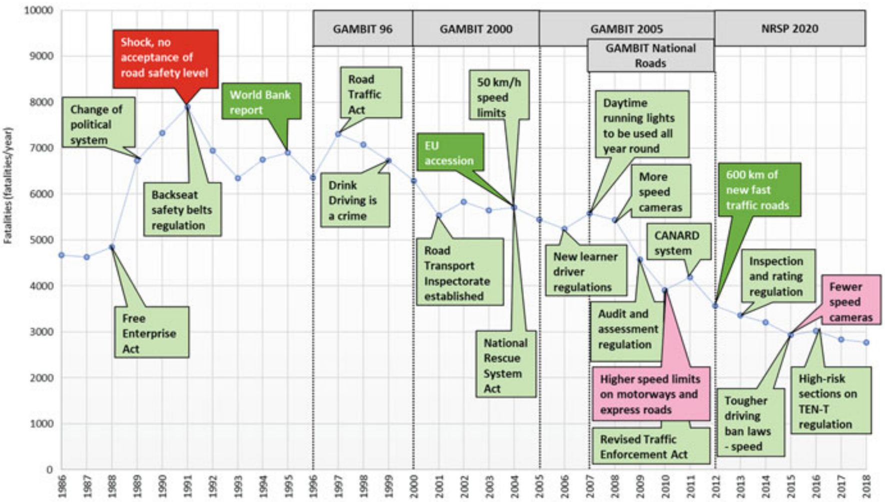



**Fig. 12** Fatalities in Poland against road safety milestones

**2000–2004** During GAMBIT 2000 (II NRSP) the reduction in fatalities reached 15% at 5712 (i.e., 1018 victims less compared to 1999). At the time the Road Transport Inspectorate was established with responsibility for controlling vehicles and transport companies just as the police. Despite numerous efforts, there were no quick results; however, over time a cumulative effect could be seen with a reduction in fatalities in the years that followed. One of the contributing factors was Poland's accession to the European Union, which led to more regulation and bringing Polish laws to the level of countries boasting much better safety.

**2005–2012** During GAMBIT 2005 (III NRSP) the national level saw a number of legislative, educational, preventive, and infrastructural efforts. However, only 84 of 144 tasks (58%) were completed. Some did not bring the expected results or were poorly performed and a number of political and administrative decisions were taken which went against the program. Many of the measures had a positive effect on Poland's road safety. They were: new regional and county road safety programs covering about a dozen regions, cities, and counties; new sectoral road safety programs (for national roads, police); start of building the Polish Road Safety Observatory and setting up two regional observatories, new driver training, and examination rules; implementation and development of an enforcement system (speed control, control of driver working time); normalizing cycling on roads; intensive construction of expressways and motorways; construction of safe junctions, pavements, and pedestrian devices (especially on rural roads); traffic calming measures; introduction of road safety audits for some projects; and modernization and development of the rescue system and post-accident care.

The effects of the III NRSP were clear especially between 2007 and 2010, when more measures were introduced such as compulsory use of daytime running lights all year round, new speed cameras making enforcement more intense, introduction of some of the tools recommended in EU Directive of 2008 on road infrastructure safety management (audit of design documentation and assessment of newly designed roads for their safety impacts on other networks). The first sectoral program was implemented, GAMBIT National Roads, mainly focusing on infrastructure and the operational program "Roads of Trust," which involved media campaigns to inform the public about road safety problems and warned against road risks. We could see the effects of EU recommended road safety principles and standards and more funding for building safe roads in Poland. The length of safe roads increased significantly during that period (in the record year of 2012 more than 600 km of motorways and expressways were completed). Thanks to the new investments and an improved enforcement system on national roads, serious accidents (involving fatalities and serious injuries) decreased and the level of risk on the roads was clearly changing (Figs. 13 and 14). New tools suggested in the Directive on road infrastructure safety management were implemented (European Parliament and the Council 2008), i.e., inspecting existing road infrastructure and classification of hazardous sections. The speed limit in built-up areas was reduced to 50 km/h (sadly the

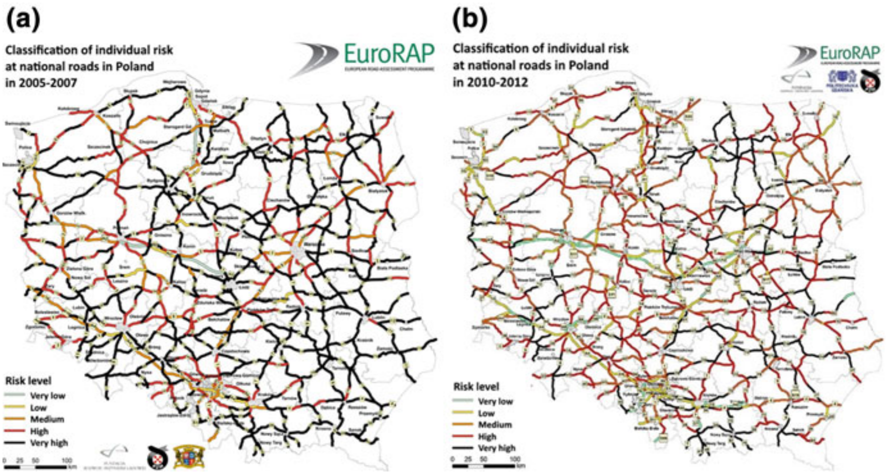



**Fig. 13** Map of individual risk on the network of Polish national roads; (**a**) between 2005 and 2007, (**b**) between 2010 and 2012

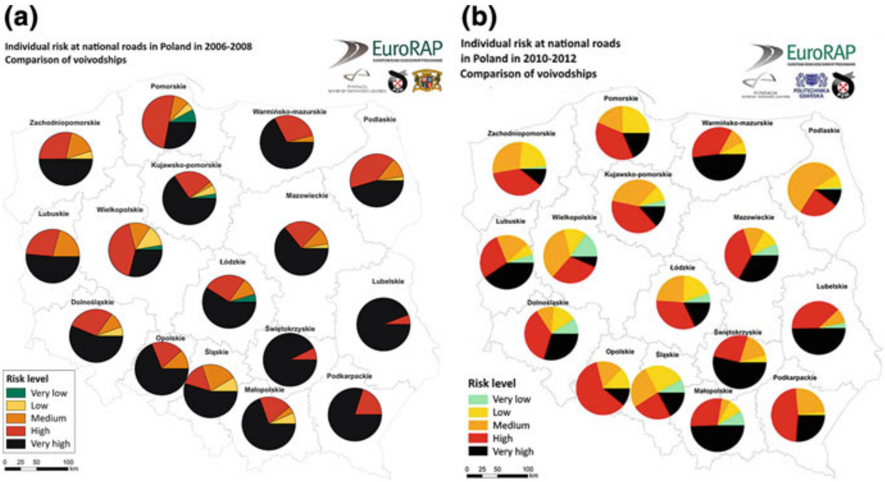



**Fig. 14** Map of individual risk on the network of Polish national roads by the regions; (**a**) between 2006 and 2008, (**b**) between 2010 and 2012

nighttime speed limit was left at 60 km/h, work is under way to change this regulation in 2020) and driving tests were amended. It is estimated that thanks to the program within 8 years fatalities dropped by 38% to 3540 (i.e., fatalities went down by 2172 compared to 2004), about 6000 people were saved from death in a road accident and about PLN 34.5 billion was saved.

Road accidents, however, were still not seen as a major problem in Poland. They did not become a political priority and the institutions proved ineffective because responsibility for road safety was shared (collective). Unfortunately, many of the key actions set out in the program were never launched. No one was appointed to a lead role regarding GAMBIT 2005 delivery, the country's road safety bodies were not improved, in particular the National Road Safety Council, no appointments were made at the local level (inspectors, officers, leaders), funding for road safety was not secured, the strategy was not monitored for its progress, and good road safety practice was not promoted. Another setback came in 2010, when the motorway speed limit was raised to 140 km/h and the expressway speed limit went up to 120 km/h. In 2011 the automatic speed camera system underwent restructuring (it was moved from the Police to the Motor Transport Inspectorate) leading to an increase in fatalities by 350 within a year. Analyses showed that Poland's road safety standards are far from the standards applied in the European Union. These imperfections became challenges when the next national road safety program was being formulated.

**2013–2020** In the first 5 years of IV NRSP fatalities fell by 20% reaching 2831 (i.e., 709 fatalities less compared to 2012). Since 2016 fatalities and serious injuries have leveled off (Fig. 15). There are some real downsides to the Program: the automatic speed camera system has a more limited coverage (2015) following the shutdown of speed cameras on local authority roads, which led to an increase in fatalities by 150 in the first year of the new smaller system and selected sectoral actions (mainly soft actions) are delivered by central bodies (Secretariat of the National Road Safety Council, Police, Road Transport Inspectorate, Fire Service). The Program's main targets are at risk with a 15–20% fall in fatalities in 2020 rather than the expected 50% and serious injuries may only fall by 3–5% in 2020 instead of the expected 40% (Fig. 15).

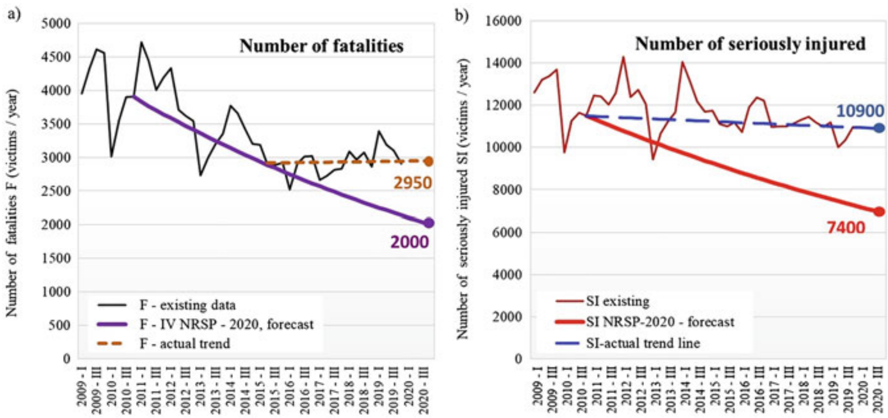



**Fig. 15** Barometer of casualty change: (**a**) deaths F, (**b**) serious injuries SI in road accidents during the IV NRSP 2020

## Prospects for Poland's Vision Zero

### Possible Scenarios

Following a series of research projects, studies, analyses, and assessments of the previous four National Road Safety Programs in Poland, steps were taken to analyze and assess the potential for delivering the Polish Vision Zero. Some recommendations were also developed regarding new road safety programs in Poland until 2050. The analysis was made using the scenario method (Stipdonk and Wesemann 2007; Koornstra 2007; EC-DGTM 2011; Zmud et al. 2013; Jamroz et al. 2019). Four scenarios were developed (shown in Table 4) setting out key strategic actions and two groups of factors: level of socioeconomic development measured with an increase in the GDPPC and level of transport policy effectiveness regarding road safety.

Using the authors' own method for long-term forecasts of fatalities described in the works of Jamroz et al. (Jamroz 2011, 2012; Jamroz and Smolarek 2013b; Jamroz et al. 2014b, 2016), a fatality forecast was made for four road safety scenarios until 2050 listed in Table 5. The baseline year is 2017 with fatalities on Polish roads at F = 2831 people and the road fatality rate at RFR = 75 fatalities/one million population.

In addition, the particular scenarios assume that parameters may change until 2030 and that a similar pace of change may continue until 2050 (GAMBIT 2018).

**Optimistic scenario S1** is characterized by a very high rate of socioeconomic development and a very strong effect of transport policy on road safety action.

Very high level of socioeconomic development includes a quick rate of the country's economic growth (increase in GDP more than 5% annually) and GDPPC at nearly 74,000 ID per capita in 2050. This will help to increase expenditures on the development of a network of modern and safe roads and a wide-ranging modernization of existing local roads, expenditure on health and rescue services on roads,

**Table 4** Potential road safety scenarios of Vision Zero in Poland

| The impact of transport policy on road safety improvements | Level of socioeconomic development (GDP growth rate) | | | |
|---|---|---|---|---|
| | Very high | High | Low | Very low |
| Very strong | S.1 Optimistic scenario | | | |
| Strong | | S.2 Moderate scenario | | |
| Weak | | | S.3 Stagnation scenario | |
| Very weak | | | | S.4 Pessimistic scenario |

**Table 5** Expected number of fatalities F, by scenario and period

| | Expected number of fatalities F (fatalities/year) | | | | Expected RFR (victims/1 m inhab./year) | | | | Summary number of people until 2050 PF (thous. Inhab./ 34 years) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Scenario | 2020 | 2030 | 2040 | 2050 | 2020 | 2030 | 2040 | 2050 | killed | saved |
| S1 | 1850 | 630 | 180 | 40 | 49 | 19 | 6 | 2 | 24.1 | 39.5 |
| S2 | 2240 | 1120 | 480 | 180 | 59 | 30 | 14 | 6 | 36.1 | 27.5 |
| S3 | 2860 | 1650 | 750 | 300 | 75 | 45 | 22 | 9 | 49.6 | 14.0 |
| S4 | 3020 | 2120 | 1300 | 750 | 108 | 57 | 38 | 21 | 63.6 | – |

transport education in schools, a safety management system, etc. The scenario assumes that population numbers will fall fairly quickly (29,600,000 in 2050 as a result of low birth rate) and that trips by car will fall (to 346 billion vkm/year in 2050).

A strong transport policy in relation to road safety action will primarily be designed to: strengthen the role of leader and that of road safety bodies, maintain a high degree of construction of motorways and expressways (up to 8000 km) and other roads of a high road safety standard, implement a wide range of activities in the area of road infrastructure safety management, reduce the role of the car and change how cities are planned, develop an automatic road traffic enforcement system (more speed cameras and sections with automatic speed enforcement, $FV_1 > 1300$), implement new systems for road traffic management (ITS, speed management), implement new technologies (autonomous and automatic vehicles), develop a system of road rescue, gain strong political support from the central level, and develop a strong safety culture of road authorities and among road users.

**Moderate scenario S2** is characterized by a high pace of socioeconomic development and a strong effect of transport policy on road safety action.

High level of socioeconomic development includes a fairly quick rate of the country's economic growth (increase in GDP more than 4% annually) and GDPPC at 63,000 ID per capita in 2050. This will help to allocate substantial funds to the development of a network of modern and safe roads and a wide-ranging modernization of existing local authority roads, expenditure on health and rescue services on roads, transport education in schools, a safety management system, etc. The scenario assumes that population numbers will fall moderately to 33 million in 2050 (modern birth rate) and that trips by car will fall (to 389 billion vkm/year in 2050).

A strong and responsible transport policy in relation to road safety action will be designed to strengthen the role of leader and that of road safety bodies, maintain a high degree of construction of expressways (to 7200 km) and other roads of a high road safety standard, implement activities in the area of road infrastructure safety management, develop an automatic road traffic enforcement system (slightly more speed cameras and sections with automatic speed enforcement, $FV_2 < 1000$). The scenario is a continuation of effective and efficient actions already started under III NRSP. It shows what fatality reductions can be achieved and the consequences if the trend is abandoned.

**Stagnation scenario S3** is characterized by a low pace of socioeconomic development and a weak effect of transport policy on road safety action.

Low level of socioeconomic development includes a slower pace of the country's socioeconomic development (increase in GDP below 3% annually) and GDPPC at 51,000 ID per capita in 2050. With a limited pool of funding less money will be spent on building a network of safe roads and modernizing the network of existing local authority roads, there will be less spending on health care and road rescue, transport education in schools, a safety management system, etc. The scenario assumes an average pace of population decrease to 33 million people in 2050 (moderate birth rate) and that trips by car will fall (to 389 billion vkm/year in 2050).

A weak transport policy in relation to road safety means lack of a leader and a limited role of road safety bodies, slower pace of building expressways (to 6500 km) and other roads of high road safety standards, slow or limited implementation of safe road infrastructure management, a limited road traffic enforcement system (including a limited number of speed cameras and sections with automatic speed enforcement, $FV_3 < 750$).

**Pessimistic scenario S4** is characterized by a very low rate of socioeconomic development and a very weak effect of transport policy on road safety action.

Very low level of socioeconomic development means a slow pace of the country's economic growth (increase in GDP below 2% annually) and GDPPC at 51,000 ID per capita in 2050. With a limited pool of funding, less money will be spent on building a network of safe roads, there will be less spending on health care and road rescue, etc. The scenario assumes an average pace of population decrease to 36.6 million people in 2050 and that trips by car will not fall (436 billion vkm/year in 2050).

A very weak transport policy in relation to road safety means lack of a leader and a limited role of road safety bodies, slower pace of building expressways (to 6500 km) and other roads of high road safety standards, no implementation of safe road infrastructure management, a limited road traffic enforcement system (including a limited number of speed cameras and sections with automatic speed enforcement, $FV_4 < 500$).

## Estimating the Expected Effects of the Scenarios, if Delivered

The assumptions and scenarios of the country's socioeconomic development and road safety-related transport policies were estimated for the reductions in road accident fatalities they can achieve. The results are shown in Table 5 and Fig. 16.

If road safety efforts were to follow **optimistic scenario S1** which represents the effect of a broader set of road safety actions, the pace of change would be likely to stay strong, i.e., about 170 fatalities annually in the next decade. The reduction in fatalities could amount to 66% over the 10 years of the Program V NRSP (between 2021 and 2030). This would make RFR = 17 fatalities per one million population in 2030, close to the rate forecasted in that period in Sweden, the Netherlands, and the United Kingdom. The scenario shows that it was highly likely that Poland's fatalities could be close to zero in 2050 with about 40,000 more lives saved from road death

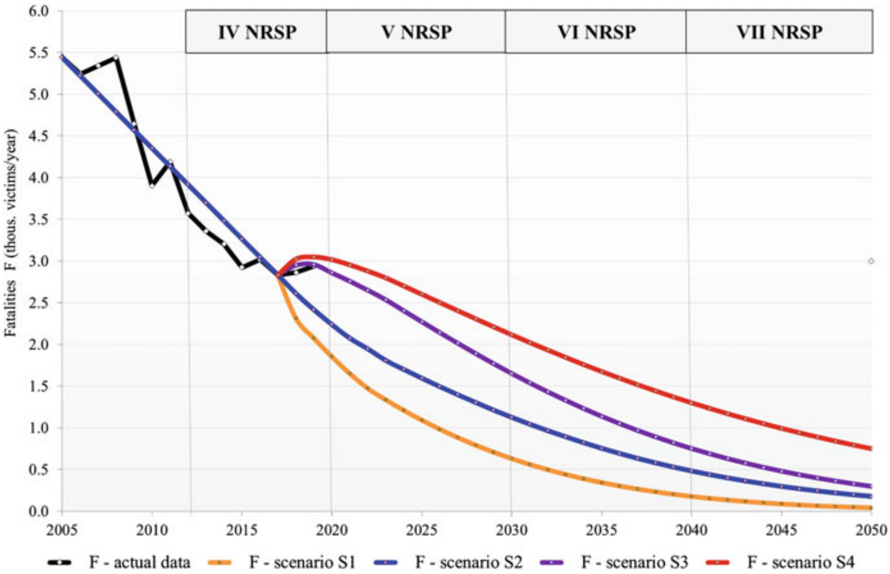



**Fig. 16** Forecast of road accident fatalities until 2050 in Poland for different road safety scenarios

than in the worst-case scenario (S4). Given the setbacks Poland's road safety system has suffered in the last few years, the fact that low-cost road safety treatments have been almost used up and that other conditions have put the brakes on positive road safety developments, the scenario is not very likely to happen.

If road safety efforts could follow **moderate scenario S2** which represents the effect of a fairly broad set of road safety actions, the pace of change would be likely to stay fairly strong, i.e., about 130 fatalities annually in the next decade. The reduction in fatalities could amount to 50% over the 10 years of the Program V NRSP (between 2021 and 2030). This would make the rate RFR = 30 fatalities per one million population in 2030 close to the rate as it is today in Sweden, the Netherlands and the United Kingdom. The scenario shows that it was fairly likely that Poland's fatalities could be close to zero in 2050 with about 27,500 more lives saved from road death than in the worst-case scenario (S4). Given the setbacks Poland's road safety system has suffered in the last few years, the scenario is not very likely to happen.

The setbacks in delivering road safety efforts and the resulting stagnation in fatalities at the level of 2016–2017 and seriously injured at the level of 2010 suggest that the number of fatalities is likely to change according to **stagnation scenario S3.** The scenario is a warning against doing less for road safety.With a limited scope of actions, the rate of decline in fatalities will slow down. It can be expected that over the 10 years of the Program V NRSP (between 2021 and 2030), the reduction in victims could be by 42%. This would make the rate RFR = 45 fatalities per one million population in 2030 higher than expected. This, however, is not enough to achieve V NRSP targets and deliver Vision Zero in 2050.

**Pessimistic scenario S4** provides a stark warning against stopping or reducing road safety efforts because the average rate of fatality reduction will be about 45 fatalities annually until 2030 and the reduction in fatalities expected over the 10 years of the Program (2020–2030) could be a mere 29%. This is definitely not enough to achieve Program targets and deliver Vision Zero in 2050.

Given the history of previous road safety efforts, stagnation scenario S3 seems most likely. Unfortunately, this scenario will not ensure the achievement of the EU's strategic goal by 2030 (reduction in the number of fatalities), so additional measures will be necessary such as moderate scenario S2.

## Guidelines and Recommendations for New Road Safety Programs

Three programming periods are envisaged on the way to achieving Vision Zero in 2050 (Fig. 16).

1. V NRSP – to be delivered in the years 2021–2030 – requires a new approach, a lot of organizational and financial effort, a change in road user behavior, road user control reinforcement, implementation of a fleet of modern vehicles equipped with new technologies, development of safe infrastructure (completion of a planned motorway and expressway network, implementation of new traffic control technologies), and changes in mobility management. Depending on the scenario, in 2030 fatality reduction F could be in the range of 3020–1850 and the RFR in the range of 110–50 fatalities per one million population.
2. VI NRSP – to be delivered in the years 2031–2040 – requires a continuation of the approach from the previous period, a further development of road safety management system, broader changes in road user behavior, development of a fleet of modern vehicles, increasing the share of public transport and alternative means of transport in modal split, development of safe road infrastructure by adapting existing roads to new standards, common use of new traffic control technologies, and development of sustainable urban mobility management. Depending on the scenario, in 2040 fatality reduction F could be in the range of 2120–630 and the RFR in the range of 60–20 fatalities per one million population.
3. VII NRSP – to be delivered in the years 2041–2050 – requires a continuation of the approach from the previous periods, improving the development of road safety management system, significant changes in road user behavior and its control, development of a fleet of modern vehicles, a significant share of public transport and alternative means of transport in modal split, development of safe road infrastructure by adapting existing roads to the newest standards (increasing requirements), common use of new traffic control technologies, and development of sustainable urban mobility management (e.g., eco-city, techno-city). Depending on the scenario, in 2050 fatality reduction F could be in the range of 750–40 and the RFR in the range of 20–2 fatalities per one million population.

Analyses have shown that an intensified effort in the initial period of V NRSP could be followed by scenario **S2** actions. This, however, requires a wide spectrum of strategic, management, and operational activities designed to develop a system of road safety, change road user behavior, develop modern vehicles, build a modern and safe road infrastructure, and strengthen the road rescue system (Wadhwa 2001; NR2C 2018).

Actions to develop a road safety system are mainly to: adapt legal regulations to new challenges, develop and implement a new national road safety program and new urban and regional road safety programs, involve nongovernmental organizations and voluntary movements.

Actions to change road user behavior are mainly to: use an automatic lock to prevent drunk drivers from starting the engine (alcolock), develop automatic enforcement and speed management (speed cameras, systems of adaptive speed management (Intelligent Speed Adaptation ISA)), pedestrian and cyclist safety devices and new systems of driver training.

Actions to develop modern vehicles are mainly to: ensure a common use of winter tires, develop devices to aid drivers (maintaining a set speed and distance, detecting conflicts), develop and implement autonomous vehicles, electric and hybrid vehicles, car co-sharing, vehicles communicating with external devices (with another vehicle (V2V), with road infrastructure (V2X), with a traffic control system (V2C)).

Actions to develop a modern and safe road infrastructure are mainly to: eliminate head-on collisions by separating carriageways (a more common use of 2 + 1, 2x2 cross-sections), eliminate side crashes by using safe junctions (roundabouts, signalized junctions), use new and safer types of interchanges, use safety devices (barriers, terminals, fencing) and devices for vulnerable road users (pavements, cycle roads, pedestrian crossings), develop autonomous and electric vehicle friendly infrastructure, take advantage of Intelligent Transport Systems. To achieve this, it is necessary to:

(a) Improve the regulations and guidelines for safe road design
(b) Develop new technologies and use adequate and durable construction materials and long life and low maintenance structural elements which guarantee a high level of safety and efficiency (object life cycle)
(c) Develop new materials, technologies, and structural parts to ensure a higher level safety for road users

Actions to develop mobility management are mainly to: implement traffic zoning, promote shared space, eliminate cars from central parts of cities (charges, public transport, cycling, ring roads), use new forms of urbanization (techno city, eco city).

Moreover, in addition to infrastructure measures and the development of road safety management tools, efforts should be undertaken and strengthened to develop the road safety culture. Actions should be aimed at changing the safety culture of individual road users by changing behavior, choosing less risky routes or means of transport, requiring and supporting actions to improve road safety. It is also important to change the approach of politicians, managers, road management employees, project offices, and media, so that road safety issues are included in everyday activities.

## Summary

The moment of adopting Vision Zero can be perceived as the beginning of systemic work for road safety in Poland. Since the III NRSP was developed and approved by the then government, Vision Zero has become not only a political slogan, but also a practical tool for the functioning of the road safety system. The vision has been included in national strategies and adopted by many cities and regions in their road safety strategies. Poland's approach to road safety has become holistic; it has started to be perceived as an important social problem and given a higher priority. In combination with the requirements of the European Union and its technical and financial support, the road safety activities undertaken in Poland brought significant effects. The problem of road safety has also gained more attention of researchers – the results of road safety analyses, Polish case studies, and evaluation of road safety measures were presented at numerous conferences and published in research journals. Local government officials, educators, journalists, policemen, paramedics, road designers, engineers, and administrators are interested and more aware of the issue of road safety. With more experience and interest in road safety, Polish institutions (i.e., national road administration), universities, and technical associations have started international cooperation, learning from better performing countries and passing on the experience of applying a systemic approach to road safety to countries with lower level of road safety (Egypt, Jordan, Lebanon, Uzbekistan, Albania, etc.).

However, the results of road safety policies are still below the expectations and many problems have not been solved. Road accidents are still not considered a major problem. As a consequence, they are low on political agendas and the institutions remain ineffective due to a sense of collective responsibility for road safety problems. Achieving Vision Zero will require many changes, learning from past mistakes, taking advantage of the experience of the best performing countries, and, above all, taking effective and efficient actions with their systematic monitoring.

Studies and analyses designed to evaluate Poland's road safety programs between 1996 and 2019 show that:

1. Ethical road user behavior, facts, research, and shared responsibility are the main pillars of Vision Zero and achieving it requires new ideas, technologies, and management systems to take account of human behavior as road users, modern vehicles, safe road infrastructure, mobility management, and development of the road safety management system.
2. A country's socioeconomic development is clearly a factor contributing to its road safety level and the main contributing factors are gross domestic product,

population mobility, level of the organizational system (level of education, level of the health care system, level of corruption), level of the development of safe road infrastructure (network of safe roads), and change in road user behavior (speed, seatbelts, alcohol).

3. The goals, priorities, strategic actions, and objectives of new programs in Poland and in other countries should be based on a model for changing a country's road safety depending on its socioeconomic development and a method for estimating fatalities.
4. The effectiveness of road safety action depends on a number of factors. The current state of science and experience of countries that have a high level of safety show that it is possible to reach a maximum effect by adopting an ambitious vision and a systemic approach to achieving goals and strategies. Key to this is having a clearly defined and science-based philosophy of action rather than myths and popular opinion.
5. Analyses show that support and advanced efforts can help to reduce fatalities in the subsequent programming periods and achieve Vision Zero in a few decades.
6. Poland's experience shows that political and systemic change can have a significant effect on positive change in socioeconomic development, which is also beneficial for road safety. In the case of Poland, it was accession to the European Community that contributed to the significant drop in road accident fatalities.

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# Vision Zero in Lithuania

# 13

Vidas Žuraulis and Vidmantas Pumputis

## Contents



**Abstract**

This chapter covers statistical data and initiatives related to the challenges and achievements of road safety in Lithuania. After providing an overview and an evaluation of previous programs to improve road safety in Lithuania, we discuss a selection of various improvements and assessment of safe traffic measures and their efficiency through relevant information from research and statistical data analysis. Priorities to achieve safer behavior of road users, safer streets and roads, safer vehicles, safer rail transport, and higher survival rates after accidents are discussed in more detail. The country-specific issues of pedestrian fatalities in

V. Žuraulis (✉) · V. Pumputis
Department of Automobile Engineering, Faculty of Transport Engineering, Vilnius Gediminas Technical University, Vilnius, Lithuania
e-mail: vidas.zuraulis@vilniustech.lt; vidmantas.pumputis@vilniustech.lt



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dark hours, intensive land transportation due to geographical location, and accidents related to railway level crossings are also presented.

**Keywords**

Lithuanian roads · Vision zero · Safe roads · Safe behavior · Safe railways · Road accidents

## Introduction

Lithuania, as a member of the European Union, aims for sustainable road transport and sets high goals in order to significantly reduce the road crash rate. Life experience in historical period of oppression left a mark on the mentality and social norms of society without excluding the road safety issues. Moreover, while high penetration of land transport in society provides undeniable benefits in everyday life, the fast evolution of machines also reveals the physical and psychological fragility of human beings. People naturally make mistakes, which comes out as injuries or fatalities; therefore, exceptional attention must be focused on this area.

The Vision Zero Declaration in transport in 2018–2030 is the Lithuanian road safety strategy aimed at preventing fatalities and severe injuries in the road transport sector. The guiding principle of this vision is the shared responsibility of transport sector managers and users, bearing in mind that the traffic environment and vehicles must be tailored to maximize the protection of the road user from potential errors and, if they occur, to ensuring effective technical and medical assistance to road users affected by the crash.

This declaration will be implemented through inter-institutional action plans that are coordinated by the Ministry of Transport and Communications. The authorities that are implementing the plans set out in the declaration must submit data on the results achieved to the Ministry of Transport and Communications within 60 days of the end of the year. This will reach the Commission on Traffic Safety for further consideration.

The Vision Zero Declaration in Transport 2018–2030 continues the efforts of previous traffic safety programs and is aligned with:

- United Nations 2030 Agenda for Sustainable Development (Target 3.6)
- Decade of Action for Road Safety 2011–2020
- for the purposes of the White Paper on Transport
- European Union Road Safety Program (2011–2020)
- National Progress Program for Lithuania for the period 2014–2020
- Verona Declaration
- Valletta Declaration

The programs and declarations emphasize common issues that are important for Europe, that is, social cohesion, greener economy, education, and innovation. These objectives are taken into account ensuring safe and sustainable mobility of all citizens and exploiting the full potential of technological progress. The program of Decade of Action for Road Safety 2011–2020 is focused on national and local level actions highlighted as safer roads and its management, safer vehicles and road users, and post-crash response. The White Paper on Transport adopted by the European Commission on 28 March 2011 states that a high priority must be given to road traffic safety, as it is essential to minimize the number of road accidents and deaths in order to improve the overall efficiency of the transport system and meet the needs and expectations of the citizens and businesses. European Union Road Safety Program (2011–2020), in addition to the actions already mentioned, declares boost of smart technologies, strengthening education and training, better enforcement, focus on motorcyclists. Verona Declaration adds attention to importance of funding, enforcement, and the use of best practices.

## Overview of Previous Programs to Improve Road Safety in Lithuania

There were three road safety programs-strategies in Lithuania from 1990 to 2017.

**The first program was in force from 2002 to 2004**. The main purpose of this program was "to ensure that fewer people comparing with 2011 are killed and affected in road crashes":

- To reduce the number of fatalities by 4% in 2002
- by 5% in 2003
- by 6% in 2004

The program target set for 2004 was not achieved as the number of fatalities on the roads started to increase rapidly between 2004 and 2006. This has been attributed to the high rate of cases of speeding, the consequences of intoxicated drivers, the low level of safety culture and discipline of all road users, etc. Equally important systemic issues include the inadequate national approach to road safety issues, including the legal framework, education and awareness, and the lack of an integrated road transport policy covering road transport development, road and street infrastructure, and road safety issues (Pikūnas and Pečeliūnas 2005). As the situation was changing, since 2007, the number of road fatalities has started to decline indicating the positive tendencies and better positioning in the context of the European Union (Tolón-Becerra et al. 2014). One of the reasons for the positive implementation of road safety was the adoption of road infrastructure management to safe design principle based engineering. Small roundabouts, speed cameras, and other engineering devices were integrated into urban and rural roads, but it is assigned to the second road safety program.

**The second program was in force from 2005 to 2010**. The main objective of this program has already been linked to that of the European Union – "to reduce the number of road fatalities in half by 2010 compared to 2004":

- to reduce road fatalities by 25% by 2008 (reached 33%)
- by 2008, reduce the number of road crash victims by 10% (reached 26%)
- by 2010, to reduce the number of road crash victims by 20% (achieved 45%)

The purpose of this program was to create conditions for the targeted and long-term improvement of safe traffic and to design and implement measures to reduce the number of road crashes. The program provided for raising the responsibility of road users, changing their behavior, improving road infrastructure, vehicle safety, and improving the legislative framework.

As part of the traffic safety program, funds were allocated for the reconstruction of high crash rate road sections, intersections, lighting, construction of pedestrian and bicycle lanes, automatic speed measuring equipment, road weather information system (KOSIS), and road safety audits for all road objects under construction and reconstruction. The program promoters were: the ministries of Transport and Communications, Health, Education and Science, Interior and Finance, Police Department, and other institutions. For example, in 2006 measures to improve road safety included the installation of 57.35 km of hiking and cycling trails and 46.6 km of protective metal barriers, elimination of 11.8 km of separate road sections, and reconstruction of 17 intersections.

The following provisions were legalized in the country in 2006:

- It is mandatory to drive with the dipped-beam headlamps on during daylight hours.
- Passenger cars are allowed to drive at 110 km/h on motorways, on the speeds up to 90 km/h on asphalt or concrete roads, and speeds up to 70 km/h on other roads (previously was 90 km/h).
- The Road Traffic Regulations (RTR) provide that if a vehicle decelerates before a pedestrian crossing, the driver of another vehicle travelling in the same direction must slow down or stop and restart only after verifying that there is no pedestrian at the crossing.
- Compulsory use of safety belts in all vehicles weighing less than 3.5 t and in buses.

To sum up the results (the number of road fatalities decreased by 33%, road injuries decreased by 45%), the program objectives for 2005–2010 were achieved with success.

**The third program valid from 2011 to 2017**. For the first time, this program mentions a long-term vision on road safety "*No deaths and no serious injuries of road users in Lithuania*" (Government of the Republic of Lithuania 2011).

The strategic objective of the program is ambitious, inspired by the success of the program of 2005–2010: "In improvement of the condition of road safety, to achieve Lithuania to be among the top 10 best performing countries in the European Union by the number of fatalities per 1 million road users (or no more than 60 per million population killed)."

Significant progress has been made in the area of road safety over the program implementation period, but the objectives set have not yet been met, and it is, therefore, necessary to find new effective solutions to reduce the number of fatalities and injuries.

High collision rates at level crossings were observed in the analysis of statistical data; therefore, in 2007, the railway safety strategy of the State Railway Inspectorate under the Ministry of Transport was approved. Based on Sweden's good example, a zero vision has been formulated: "A safe society and safe rail transport without fatalities and injuries." Based on this zero vision, measures to reduce fatalities, injuries, and the prevention of road crashes were included in safety strategy.

**Our achievements: Lithuania in the local and in the European context.** The number of road traffic fatalities and injuries in Lithuania has changed significantly over the last decade. From 2007 to 2011, the number of registered road crashes and injured persons decreased rapidly (Fig. 1). The rapid decrease in 2006–2008 is linked to the intensive implementation of engineering traffic safety measures on the roads and streets of the country, intensified traffic law enforcement of driver violations, tightening of sanctions for violations, and the changed focus on traffic safety education. Another indirect cause is the impact of the economic crisis, which has significantly slowed down the road freight transport in the country. In 2008 about 25% fewer incidents of road crashes were registered in Lithuania, and their volume was almost twice as low in 2011 compared to 2007.

Overall, the number of road crashes and injuries in Lithuania was reduced by more than half in 10 years, but worse periods with temporary increase of accident rate have not been avoided since 2011. The number of road fatalities has also been decreasing over the last decade. In 2008, compared to 2007, road fatalities had fallen

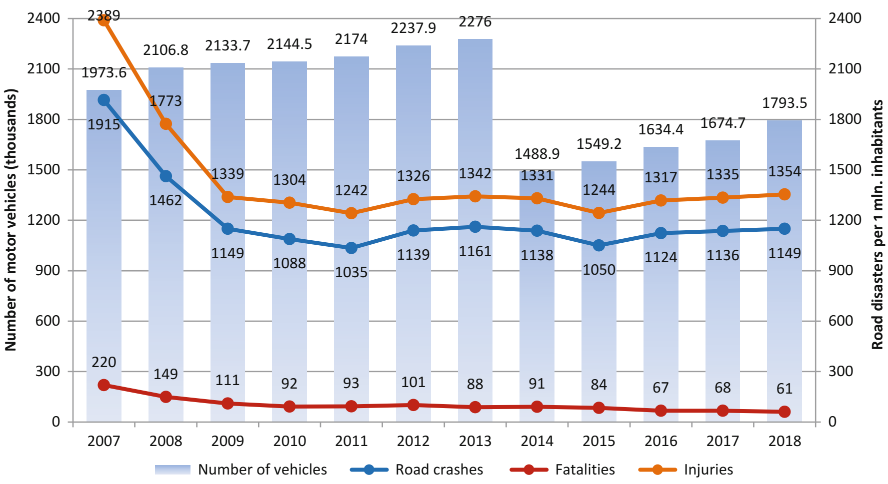


**Fig. 1** Number of registered vehicles, road crashes, injuries, and fatalities in 2007–2018. (Source: Lithuanian Road Administration (LRA) 2019)

by 33%, and they have already been reduced by half in 2009. In 2011, compared to 2007, 60% fewer fatalities were recorded. Since 2011 the number of road fatalities in Lithuania changed insignificantly and unevenly. The number of road fatalities in Lithuania decreased more than three times in 10 years period (Fig. 1). Nonetheless, these results are not encouraging, as they were achieved in the background of the extremely alarming previous period when the number of road fatalities used to exceed 600 per year (Pikūnas and Pečeliūnas 2005). Despite the results achieved, the started works must be continued and extended by new means.

At the beginning of July 2014, the country introduced changes to vehicle registration procedures, which are also reflected in the analysis of national statistics (Fig. 1). Under the new regime, vehicles without compulsory civil liability insurance and (or) roadworthiness tests have been de-registered, resulting in a reduction of the vehicle fleet by more than one-third. Now, these data are more in line with the actual number of vehicles on the country's roads, but the upward trend remains evident, reflecting the intensive road transport in Lithuania.

In 2010–2018 Lithuania's progress in reducing road crashes had been assessed in the context of the European Union. The second best crash reduction rate achieved (−43%) and the Road Safety Performance Index (PIN) rating are shown in Fig. 2. This PIN indicator is established by the European Transport Safety Council (ETSC), a Brussels-based, independent nonprofit organization dedicated to reducing the numbers of deaths and injuries in transport in Europe (ETSC 2019). Lithuania has

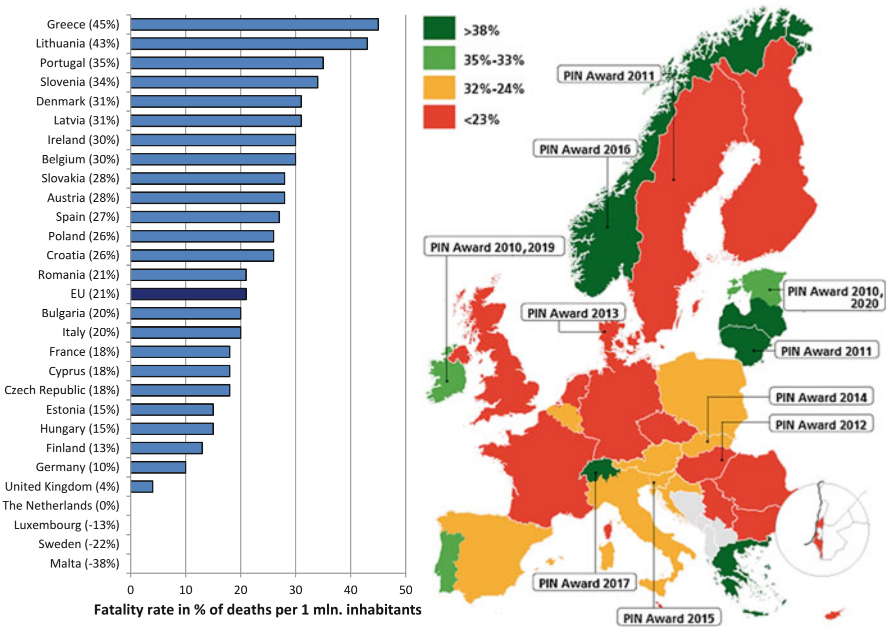


**Fig. 2** Relative change in road deaths between the period 2010–2018 (left) and map of Road Safety Performance Index (right)

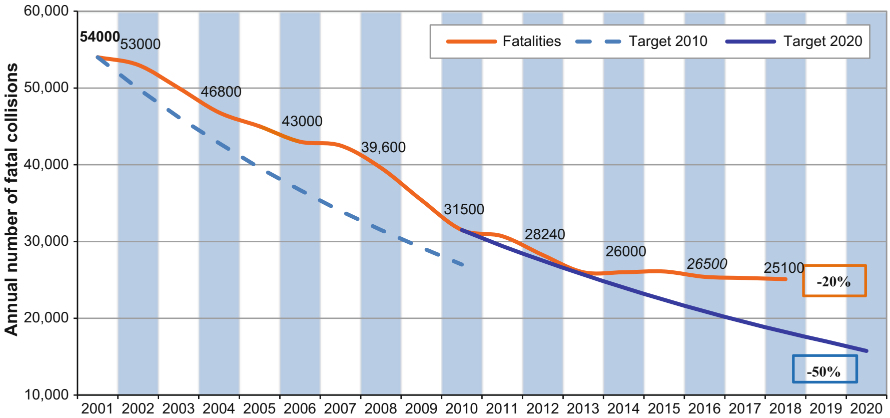


**Fig. 3** EU fatalities in road accidents and targets 2010–2020. (Source: CARE – EU road accidents database)

taken a significant step toward the safer road transport but remains below the EU average (Fig. 2).

In 2016 there were 25,500 road fatalities in the European Union, 1.5 million of road users were injured. In 2016, a total of 67 people died in road crashes in Lithuania per 1 million of population, whereas the European Union has an average of 50 fatalities per 1 million of population. The trend of this period reflects a consistent move toward the European Union's goal of halving the number of road fatalities over the last decade. Nevertheless, the EU road accident statistics of recent years is not improving in accordance with the set scenario (Fig. 3). In 2018, the EU average was 49 fatalities per 1 million of population.

Despite the results already achieved, Lithuania remains a high road traffic risk country compared to other EU member states. In 2018, 60.5 people died in road crashes per 1 million of population. Even taking into account the shrinking population and investment in road infrastructure and public education and awareness, the number of road crashes in the country is significantly higher. Such statistic is characteristic to most East-Central European countries (Fig. 4).

## Needs for Building Strategic Directions

For the second consecutive decade, international organizations such as the United Nations and the European Commission are formulating objectives on the road safety for the decades to come (UNECE 2019; European Commission 2019). Meanwhile, the main goal is to reduce the number of fatalities to zero by 2050. The current road safety objectives of these organizations are linked to the year 2020 and the prospects for 2030 are already planned. As Lithuania usually sets its goals in the field of road safety in accordance with the objectives of the European Commission, a new strategy (as a vision) is envisaged.

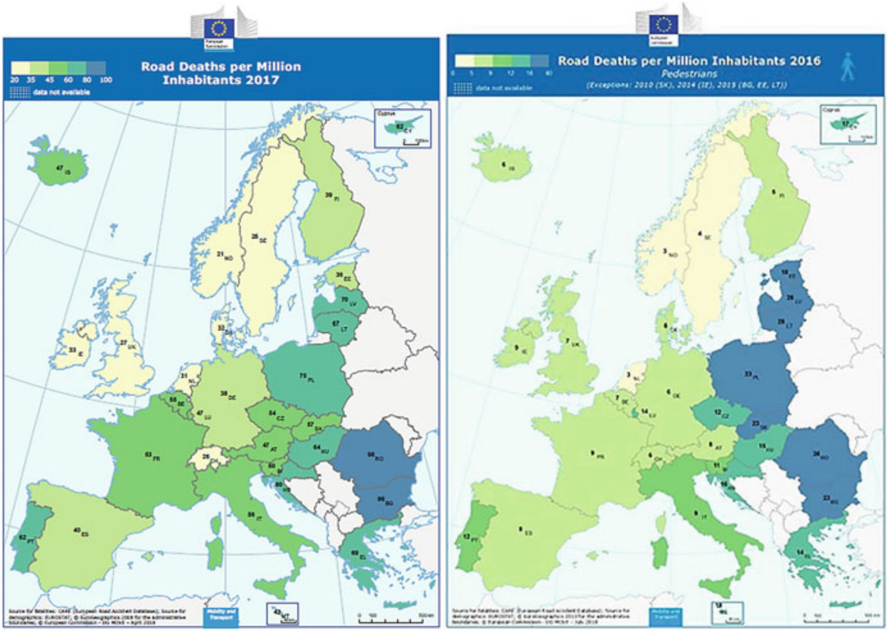


**Fig. 4** Europe's map for road deaths per million inhabitants, 2016–2017. (Source: CARE)

## VISION – ZERO IN TRANSPORT IN 2018-2050

The third Lithuanian Road Safety Program, valid for 2011–2017, formulated a long-term vision on road safety "No road user is killed or seriously injured in Lithuania." The importance of such a vision has not diminished; on the contrary, it is largely followed by the international community. As the current situation in the field of traffic safety remains intolerable, this vision is further pursued in Lithuania.

**Essential measures to improve road safety**:

- Improvement of infrastructure on state roads.
- Stricter sanctions for offenders.
- Zero promille of blood alcohol level (BAC) for certain driver group + the legitimation of Alcolock idea.
- The average speed enforcement has started.
- Close cooperation between institutions in organizing educational activities.

Unlike the previous one, the new program in addition to objectives defined and tasks formulated for each of them has measures already provided for and the specific institutions assigned to their implementation. Evaluation criteria, expressed in quantitative values, are provided for the implementation of the goals and objectives of the program. For example, (i) the task to reconstruct dangerous intersections on main and national roads is intended for the Lithuanian Road Administration. It provides for the responsibility to reduce the number of accidents in 2025 by 90%, and in 2030 by 100% compared to 2018. (ii) The Lithuanian Transport Safety Administration and the Police Department have the task and responsibility to perform roadside inspections of the technical condition of vehicles in 2025 – 7% and in 2030 – 8% from the fleet. It is expected that more specific tasks and responsibilities will better achieve the stated objectives of the new program.

## Selection of Specific Measures for Traffic Safety Improvement and Evaluation of Its Efficiency

The guiding principle of the program "Vision Zero" is based on shared responsibility of the road traffic managers, vehicle manufacturers, and companies representing the interests of the manufacturers for road safety, that is, the traffic environment and vehicles must be designed and maintained to help road users avoid errors, and in the event errors, to have the least possible consequences, and the road users must act the way that does not pose a risk to themselves or others (National Road Traffic Safety Programme "Vision Zero" 2020).

**TARGET – zero fatalities and serious injuries in road transport**

Significant attention is directed toward the prevention of deliberate violations of road traffic regulations, development of the safer road infrastructure, management of safer vehicle fleet, and mitigation of the consequences of road crashes. The following subsections are the description of the identified issues and selected measures addressed for safer behavior of road users, safer roads, safer vehicles, and more efficient rescue assistance.

### First Priority: Safer Behavior of Road Users

#### Compliance with Permitted and Safe Speed

In accordance with the analysis of accident data of the country, it has been found that the most common factors of fatal crashes are related to noncompliance with safe driving, as defined in the traffic rules. It includes the human risk factors, among them, the unsafe speed of a vehicle in a bend of the road – 9%. In Lithuania, as many as two out of three drivers in the territories of settlements exceed the permitted speed. Observations show that 17.6% of motorists exceed the speed limit on motorways of more than 10 km/h, and same can be said about 31.6% of drivers on state roads and 19.2% of drivers on regional roads. This encourages the pursuit of compliance with **the speed limits as a habit for drivers**.

Exceeding the speed is the most common violation of traffic rules and safe driving principles both in Lithuania and in many other countries. Unfortunately, there is a prevailing perception among drivers that exceeding the speed up to 10 km/h is not a violation and does not interfere with road safety. However, even a slight over speeding will result in longer reaction time of the driver, more complex car handling in unexpected circumstances and adverse conditions. Unfortunately, drivers do not see the problem speeding above 10 km/h. This is due to a lack of awareness of how increases the risk of driving and the possible consequences of colliding with another vehicle or hitting a pedestrian even at low speeding. Long-term tolerance of low speeding, including the relatively high tolerance of speed cameras, has also contributed to this attitude and behavior of most drivers. Unfortunately, when individual drivers do not exceed the speed limit at all (often buses or trucks with speed limiters), they become objects of continuous overtaking. This further increases the risk of driving, so the control of unsafe and right-hand overtaking, as well as speeding without tolerance, must remain an active means of implementing safe driving.

The National Police Department has started controlling the speed of cars on state roads using sectorial speed meters and the number of sections that record cases of average speed violations are expanding. In the coming years, a total of 130 average speed measuring sections will be installed in the country (Fig. 5). The network of

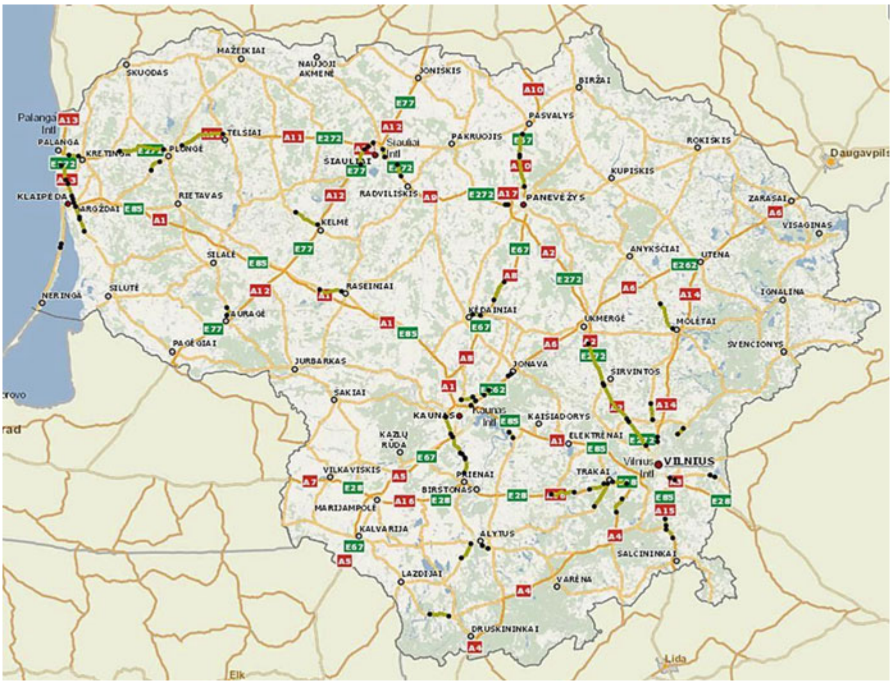


**Fig. 5** Estimated average speed measurement sections on Lithuanian roads. (Source: LRA 2019)

**Table 1** Implementation of permissible and safe speed compliance. (Adapted from National Road... 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Change of the legal base | | |
| Change the legal base by introducing a zero tolerance for speeding | The introduction of lower tolerance for speeding is intended to reduce the cases of speeding | 30% reduction in the number of drivers exceeding the speed limit in settlements up to 10 km/h |
| Road users education | | |
| Emphasizing the risks of speeding in a social advertising campaign | Modern and attractive forms of education will be used to explain the risks of speeding | At least 50% of respondents in the public poll report that social advertising has had a positive impact on their behavior in traffic, particularly in respect of speed limits |
| More efficient supervision | | |
| Development of an automatic speed control system (including insurance, roadworthiness tests, etc.) on country roads | On the sections where an automatic speed control system will monitor the speed, the number of speeding and registered crashes will be reduced | A number of registered crashes on the road sections with automatic speed control reduction after the implementation of the control system on the section by at least 80% |
| The inevitability of penalties for severe violations of RTR (especially for speeding) | In case of detection of a severe RTR infringement by automatic means on a vehicle registered in another EU country, a report is sent to the owner of the vehicle | Contract on data exchange in accordance with Directive (EU) 2015/413 of the European Parliament and the Council has been signed with at least 20 member states |

instant speed cameras is also expanding by installing 70 cameras (15min.lt 2019). These tools are directly focused on law enforcement on the permitted speed limit.

Table 1 shows the measures, the expected effects, and evaluation indicators to address the issue of compliance with admissible and safe speed. In the context of the various measures to implement road safety, it is important not only to define those instruments clearly but also to anticipate their effects. When applying measures at the level of national regulation, it is very important to provide an indicator of evaluation for each measure – the best-achieved result in terms of quantity. This format will continue to apply to other measures described.

After implementing measures to improve traffic safety in the long-term, the proportion of motor vehicles exceeding the speed limit in Lithuania in settlements is expected to reduce from 68% in 2014 to 60% in 2025 and up to 45% in 2030.

### Public Intolerance of Drunk Driving

In 2019 alone, drunken road users (drivers, motorcyclists, cyclists, pedestrians) caused 265 road crashes, resulting in 351 injuries and 25 fatalities. The statistics for the last four years have not changed significantly, and that warns of the

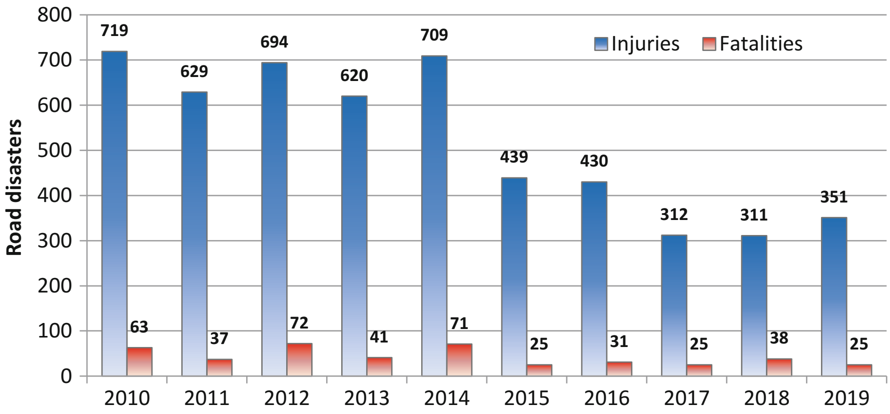


**Fig. 6** Alcohol-impaired road traffic fatalities 2010–2019. (Source: Lithuanian Police)

ineffectiveness of the measures currently taken. The statistics for the period 2010–2019 due to road disasters caused by drunk road users is presented in Fig. 6.

Between 2013 and 2016, the highest numbers of fatal crashes (23% of all fatal crashes caused by road users) were due to the impact of alcohol: 14% for drunk drivers, 8% for drunk pedestrians, and 1% for drunk cyclists. **It is therefore planned to achieve that the public does not tolerate driving under the influence of alcohol or psychoactive substances**. The following are the main reasons identified as to why drivers are drunk while driving in the country:

- Drivers hope a police officer will not catch him on the road
- It is naively believed they succeed in making a "consensus" with a police officer on the road.
- They do not know the exact details of imminent sanctions and all the hassle in recovering a driving license.
- High availability of alcoholic beverages (ban on their trade-in petrol stations and limited time after trading in shops).
- Public indifference toward drunk drivers.

Successful measures to reduce the number of drunk drivers in foreign countries:

- The consequences of alcohol use for each individual and society as a whole are publicly and clearly identified (health, early mortality, increased injuries at home and work, long-term decline in the quality of life and satisfaction).
- Significant strengthening and publicizing the sanctions for unauthorized alcohol use.
- Thorough traffic law enforcement by officials (the inevitability of criminality).
- Ongoing intensive educational campaigns to explain the harm of alcohol and the improvement of people's lives without alcohol.

- Promotion of more sports, active recreation and leisure without the excessive alcohol or food consumption (development of cycle path infrastructure, public urban spaces, parks, restriction of access to alcohol and fast food).

In 2016 the country set a legal limit of zero promille of BAC for the following groups of drivers: novice drivers, drivers of a taxi, motor vehicles, mopeds, motorcycles, tricycles, light quadricycles, quadricycles, power quads, vehicles with a maximum permissible mass exceeding 3.5 tons or with more than nine seats or carrying dangerous goods. It has been agreed during the revision of the legal liability of road users that the installation of alcolocks in vehicles should be done on a voluntary basis. Choices are offered: disqualification from driving or a reduced term for driving disqualification, but compulsory participation in a rehabilitation program and the use of alcolock system in the vehicles. Drivers who install alcolocks on their vehicles and undergo the drunk driving rehabilitation programs could reduce their disqualification term by a factor of two. As of 2016, alcolocks are installed on all new school buses reaching the country's roads.

Educating road users through the involvement of alcoholic beverage manufacturers, more effective supervision through intensive police checks are also effective tools. A variety of road safety education activities are carried out by most public authorities or nongovernmental organizations in the EU (such as the European Transport Safety Council (ETSC), the International Traffic Safety Data and Analysis Group (IRTAD)), both in a combination of actions by police officers or stricter controls on certain groups of road users (e.g. educational activities against a drunk driver, at the same time the enhanced control of driver intoxication enforcement). See Table 2 for additional measures, expected effects, and assessment indicators for the problem of intoxicated driving.

After the implementation of measures to improve traffic safety in the long term, it is estimated that in Lithuania the number of road crashes caused by intoxicated road users would decrease from 307 in 2017 to 100 in 2025 and to 50 in 2030.

### No Use of Mobile Devices

In Lithuania, about 45% of drivers talk on the phone without a headset while driving a vehicle and about 30% of drivers write messages. About 16% of drivers also browse their smart devices while driving, and this behavior is playing an increasingly important role in life and is rapidly growing. Using a phone negatively affects driving safety in two ways: it physically complicates the operation of the vehicle, especially in unexpected or sudden changes in driving conditions, and distracts the driver's attention and thoughts from monitoring and interpreting the traffic environment, thereby increasing his response time (Žuraulis et al. 2018).

It is intended **to prevent drivers from using a mobile device while driving a motor vehicle**. Measures, expected effects and evaluation indicators to address this problem are presented in Table 3.

After implementing measures to improve traffic safety in the long term, it is estimated that in Lithuania, the number of drivers using mobile communication

**Table 2** Implementation of public intolerance to drink driving. (Adapted from National Road… 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Change of the legal base | | |
| To prepare a rehabilitation program for drivers who violated the RTR while driving when their blood alcohol levels exceeded the legal limits | Drivers opting for a rehabilitation program will be allowed to drive motor vehicles with integrated engine blocking equipment that responds to alcohol concentration in the driver's exhaled air | The program includes at least 50% of the drivers disqualified from driving under the influence of alcohol |
| To carry out an in-depth analysis and improvement of procedures and methods to determine whether or not road users are /were intoxicated with narcotics, psychotropic and other psychoactive substances | This measure aims to improve procedures and methods for determining whether road users are/were under the influence of narcotic substances | Police are using new procedures and methods to determine whether or not road users are intoxicated with narcotic substances |
| Road users education | | |
| Social advertising emphasizes the dangers and risks of driving under the influence of alcohol or psychoactive substances | Modern and attractive forms of education are used to explain the risks of driving under the influence of alcohol or psychoactive substances | At least 50% of respondents of the public poll report that social advertising has had a positive impact on their behavior in traffic, in particular by discouraging them from driving under the influence of alcohol or psychoactive substances |
| More efficient supervision | | |
| On a large scale, to perform the law enforcement of driving under the influence of alcohol or psychoactive substances | Frequent and continuous law enforcement campaigns of driving under the influence of alcohol or psychoactive substances in the whole of Lithuania for non-compliant drivers will mean the inevitability of sanctions. | A 5% annual reduction in offenders in road crash who ignore the prohibition of driving while under the influence of alcohol or psychoactive substances. |

devices, in the way prohibited by the RTR, will reduce from 45% in 2016 to 10% in 2025 and to 5% in 2030.

It is important to note that using a mobile device for calls or surfing is dangerous not only from the drivers' part but also from other road users. Pedestrians pose a danger to themselves and others by focusing their attention on the phone screens at intersections, pedestrian crossings or their accesses. In order to draw the attention of such pedestrians, pedestrian footpaths are equipped with loudspeakers that signal the danger of entering the street under a red traffic light (Fig. 7). Also, warning signs are painted on the pavement just in front of a pedestrian crossing in the hope that it will draw the attention of pedestrians who are with their heads in the phone (browsing).

**Table 3** Implementation of non-use of the mobile device while driving. (Adapted from National Road. . . 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Change of the legal base | | |
| Changing the legal framework by introducing a zero speed tolerance for unauthorized use of mobile devices while driving | The legislative changes are intended to reduce the number of unauthorized use of mobile devices while driving | A reduction of at least 20% in the number of unauthorized use of mobile devices while driving |
| Road users education | | |
| The emphasis during social advertising of the risks arising from driving and using mobile devices in an unauthorized manner | Modern and attractive educational forms will be used to explain the risks of unauthorized use of mobile devices while driving | At least 50% of respondents in the public poll report that social advertising has had a positive impact on their traffic behavior, namely, avoidance of the unauthorized use of mobile devices while driving |
| More efficient supervision | | |
| To carry out the law enforcement campaigns and their publicity on the avoidance of the use of mobile devices by hands while driving | Talking on a cell phone without using a headset, texting or surfing the Internet while driving is one of the causes of serious road crashes and therefore this tool is intended to alert drivers to the risks and consequences and to raise driver awareness | More than 70% of drivers are not using the phone without a handset while driving<br>More than 80% do not write short messages while driving<br>More than 90% of them do not surf the Internet while driving |


**Fig. 7** Audible and visual means to draw the attention of pedestrians using phones at pedestrian crossings

The LED strips on pavement crossings in front of the pedestrian crossings in the sidewalk in several cities of the country have drawn the particular attention of the public (Fig. 8). Along with the traffic lights, these strips are illuminated red or green and are very noticeable and ensure a good warning at dusk or when it is completely dark. Such a means is also focused on the attention of pedestrians who constantly divert their gaze to the phone screen.

**Fig. 8** Pavement LED stoplight strips are mounted to duplicate traffic lights and draw the attention of pedestrians using phones

Listening to music through headphones in heavy traffic areas, which limits the perception of pedestrians and cyclists, is also dangerous. In some cases, this may prevent the traffic participant from hearing special vehicles with acoustic signals. Understandably, it is not possible and reasonable to apply the tightening of liability for all cases. Therefore the long-term public education and awareness-raising of the public must remain a priority strategy in the improvement of road safety. In the case of use of mobile phones education of road users by involving mobile operators, insurance companies or nongovernmental organizations popular in the public domain is also considered a useful tool.

## Use of Reflective Elements

In 2018 the most significant number of pedestrians were killed on Lithuanian roads and streets – as much as 40% of all road users (Fig. 9). There were 1021 hits of pedestrians by cars, with 1024 pedestrians injured and 69 killed. Of these, 327 persons were injured, and as many as 52 were killed at night. The distribution of road fatalities and injuries in Lithuania in 2018 is shown in Fig. 9.

Autumn and winter are characterized by long dark hours and unfavorable traffic conditions, which worsen road safety for the most vulnerable road users – pedestrians. Autumn and winter account for about 70% of all pedestrian hits. The majority of pedestrian fatalities are older citizens (>64 years), which is related with their lax approach to safety measures (reflective vests, reflectors) and their proper use or human recklessness. Meanwhile, young people (aged 15–34) make up the majority

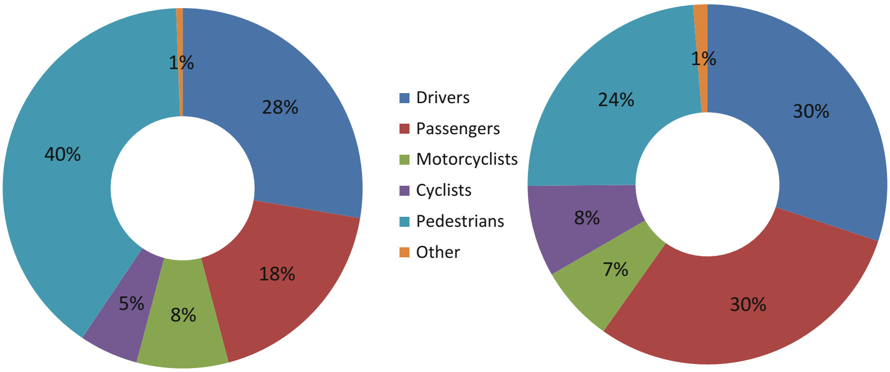


**Fig. 9** Deaths (on the left) and injuries (on the right) by road user category in 2018. (Source: LRA 2019)

of injured pedestrians. Risk in this age group is explained by a lack of focus and a characteristic hasty behavior. Nevertheless, due to the high number of pedestrian fatalities, the state authorities responsible for the design, renewal, and periodic maintenance of road infrastructure also have a significant role to play. A significant number of pedestrian-hazardous road sections can be predetermined and adapted to safe pedestrian traffic – paved paths with barriers from the carriageway, maintained roadsides, controlled speeding, necessary road signs built, and other engineering measures to improve traffic safety equipped.

The Road Transport Research Institute, which is currently expanding its activities to include air transport and licensing, is now operating as an Agency for Transport Competencies, contributing significantly to the monitoring and prevention of road crashes in the country. In 2014 and 2016, the Institute conducted a study on the use of reflectors during the dark hours (KTTI 2016a), monitoring pedestrians and cyclists on 30 state roads at public transport stops, shops, and other places near resident attraction points. The study showed that about 22% of all pedestrians and cyclists do not use reflectors, and about 21% are misusing them in the dark hours. The use of reflectors by different groups of vulnerable road users is presented in Fig. 10. The same study was conducted by the Institute in 2014. Comparing the results, in 2016, the number of road users using reflectors during the daytime increased by 14%, the number of them misusing them increased by 16%, and the number of road users not using them during the dark hours declined by 30%. This demonstrates the need to continue educational campaigns on reflector distribution and awareness of their use.

The importance of reflectors is evident, as a pedestrian wearing a reflector, a vest or other clothing with reflective elements is visible from a distance of 300 m, and without reflectors only from a distance of 100 m from a vehicle with high beam headlamps on. When the vehicle is passing with the dipped-beam headlamps on, a pedestrian with reflective elements is noticeable from a distance of 150 m and only from 50 m without them. In these circumstances, even at a speed limit of 50 km/h,

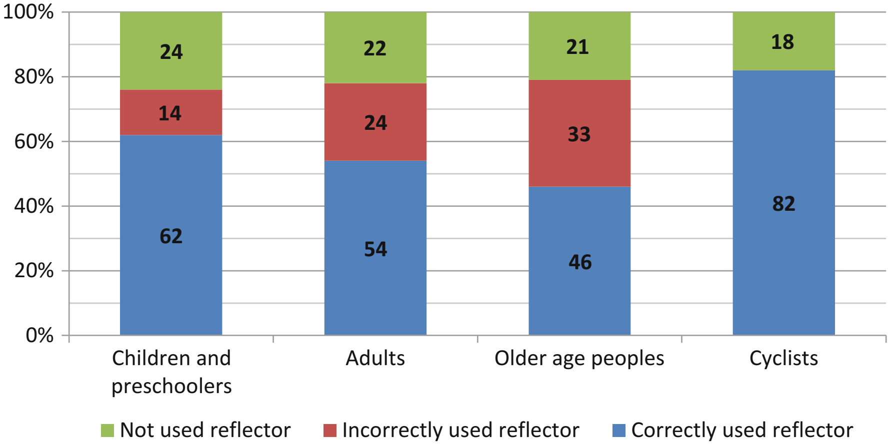


**Fig. 10** Use of reflectors in accordance with the monitoring carried out in 2016 on the roads of national importance. (Source: KTTI 2016a)

the driver will be able to stop the vehicle from a distance of at least 35–40 m on wet surfaces, taking into account his reaction time in the dark (1.2–1.5 s). It is therefore important to seek that **vulnerable road users (pedestrians, cyclists) make appropriate use of reflective elements during the dark hours**. This involves the education of road users through the active involvement of municipalities and supervisory enforcement activities (Table 4).

In the long term, after implementing measures to improve traffic safety, the proportion of road users who do not use reflectors or similar devices at all and misuse in Lithuania is expected to decrease from 43% in 2016 to 30% in 2025 and 15% in 2030.

### Use of Seat Belts in Rear Seats and Child Seats

The consequences of road crashes are heavily influenced by whether the occupants of the vehicle are wearing seat belts or not. Over the period of 2013–2016, it has been recorded that almost one-fifth of road users were not wearing seat belts. Seat belts in the front of the vehicle in Lithuania are used by 97% of vehicle occupants, while only 30% wear them when sitting in the back (including child seats) (KTTI 2016b); therefore, **correct use of seat belts in child car seats and the rear seats of the vehicle must be encouraged**. Measures, expected effects, and evaluation indicators to address this problem are presented in Table 5.

Following the implementation of measures to improve traffic safety in the long term, it is estimated that in Lithuania, the proportion of vehicle occupants in the rear seat wearing seat belts (including child seats) will grow from 30% in 2016 to 60% in 2025 and to 95% in 2030.

**Table 4** Implementation for use of reflective elements by road users. (Adapted from National Road. . . 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Road users education | | |
| Emphasize the risks of not using or misusing reflectors or other visibility enhancers during the dark hours should be made in social advertising | Modern and attractive forms of education will explain the risks of not using or misusing reflectors or other visibility enhancers at night | At least 50% of respondents in the public poll report that social advertising positively influenced their behavior in traffic, namely, in promoting the use of reflectors or similar visibility enhancers at night and explaining the risks of their misuse |
| More efficient supervision | | |
| To conduct the traffic law enforcement campaigns and publicize the use of reflectors | One-fifth of all pedestrians, cyclists, and riders misuse the reflectors. Significant reductions in pedestrian fatalities are expected. Autumn and winter are characterized by long dark hours and unfavorable traffic conditions, which reduce road safety for unprotected road users, pedestrians. About 70% of all pedestrian hits occur in winter and autumn | More than 90% of all pedestrians, cyclists, and riders of state roads use reflectors in the dark.<br>The reflectors are used by more than 90% of pre-school age youth, more than 85% of middle-aged people and more than 80% of elderly people<br>Reflectors in the dark I used by more than 90% cyclists<br>Among all reflector users, more than 90% pedestrians, cyclists, and riders use reflectors correctly. |

## Higher Driving Culture and More Responsible Pedestrian Behavior

Road users cause about 90% of road accidents, and this is a common issue in Lithuania and other countries on average. Most road crashes are the result of deliberate violations of road traffic regulations or safe driving principles (e.g. safe speed selection) by road users. The behavior of road users on the road is heavily influenced by the monitoring of compliance with traffic regulations and the application of impact measures on road traffic offences. Involving more intensive traffic law enforcement as automated speed control, frequent and fast intoxication tests, seat belts and child seats (especially sitting in the back), as well as unauthorized use of mobile devices control will lead to more responsible drivers' behavior and less violation of RTR. Public intolerance occurring as announcements about obvious violations of RTR, and of course, education of the public about RTR violations is also crucial. The basic principles of road safety must be built during special activities at school. They should familiarize the young road users with the basic rules of the road and why they must be obeyed. It is also important, in the initial phase of driver training, not only to train young drivers of the rules of the road traffic and to provide

**Table 5** Implementation of seat belt fastening. (Adapted from National Road… 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Road users education | | |
| Emphasizing the dangers of driving with seat belts off, emphasizing the use of seat belts in rear vehicle seats and city buses and the safe transport of children in social advertising | Modern and attractive forms of education will be used to explain the dangers of driving with seat belts off | At least 50% of respondents in the public poll report that social advertising has had a positive impact on their behavior in traffic, namely, through the promotion of using seatbelts in rear seats and coaches and the safe transport of children |
| More efficient supervision | | |
| Carry out and publicize the campaigns of wearing seat belts for front and rear-seat passengers and seat belt fastening for passengers in buses and country buses | Due to the failure to use seat belts, many people are still injured or killed in road crashes. The measure would encourage the use of seat belts, including seat belts in rear vehicle seats and country buses | 98% of front passengers wear seat belts<br>50% of passengers in the rear wear seat belts (including child seats)<br>In coaches equipped with seat belts, they are used by 50% of passengers |
| Carrying out and publicize the traffic law enforcement of children's transport in seats (seats, seating systems) adapted to their height and weight | Carriage of children in places not adapted for this purpose may result in injuries or loss of life during road crashes. The measure would encourage the transport of children in seating positions (seats, seating systems) adapted to height and weight | The proportion of children carried in seating positions (seats, seating systems) adapted to their height and weight, to be at least 80% of all children carried |

them with the necessary skills but also to ensure their responsibility and mutual respect. Drivers training and examination system and the interrelations between the institutions involved in this process play an important role here (Valiūnas et al. 2011). To reduce the road crash rate, Lithuania should pay greater attention to development of a road safety based training system, including practical and safe traffic skills in drivers, special training of professional drivers, and improvement of their qualification. The system should ensure improving the qualification of drivers, continuous training of drivers, and examination of their knowledge as well as the development of traffic safety knowledge and skills in road users of all age groups.

In order to achieve **a higher driving culture and more cautious and responsible pedestrian behavior**, the challenge is to reduce the number of abusive driving situations dangerous to others, as well as to reduce the behavior of non-cautious pedestrians (especially children and seniors). Here the role of system designer is envisaged for special attention to the development of safe pedestrian and cycling infrastructure. For this reason, it is necessary to separate the pedestrian and bicycle traffic from the motor vehicle traffic, expand quiet traffic areas with speed limited to 30 km/h – near schools, children's playgrounds, healthcare institutions, shopping centers, parks. Other

**Table 6** Implementing a higher driving culture. (Adapted from National Road. . . 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Change of the legal base | | |
| Encourage candidate drivers to acquire as many driving skills as possible before passing the practical driving test | The aim is to encourage to acquire as many practical driving experience as possible before taking the practical driving test. Studies have shown that the learning of practical driving skills for about 120 h (including training with a family driving instructor), after getting a license, the chances for a beginner driver of being involved in a road crash are reduced by 40% | 50% of applicants seeking to acquire the right to drive category B motor vehicles, before passing the practical driving test, acquire practical driving skills while driving for at least 50 h |
| Road users education | | |
| Examining road crashes, their causes and selected measures, sharing them with driving schools and publicizing | The aim is to provide road users with information that will help them avoid errors in their behavior on the road | Thematic plans for driver training have been supplemented with new, relevant topics that would contribute to increasing traffic safety |
| More efficient supervision | | |
| Encourage road users to report cases of reckless driving or other violations | The aim is to raise public intolerance for the abusive driving that endangers the lives and health of other road users | Surveys show that driving culture is improving |

measures, expected effects, and evaluation indicators to address to a higher driving culture and more responsible pedestrian behavior are presented in Table 6.

Government of the country back in 2016 has endorsed the Code of Administrative Offenses, which provides for stricter liability for violations of the rules on vehicle overtaking, dangerous and reckless driving, therefore currently the sanction for violation of overtaking rules includes a fine and the withdrawal of the right to drive from 3 to 6 months. In the event of loss of a driving license, additional medical examinations have to be passed (if the right of driving has been Substandard because of being intoxicated with alcohol or other substances), to receive a certificate of health knowledge certification and to attend additional driver training courses. The content of the latter courses includes a lecture on the accident levels and prevention of road crashes, a conversation with the psychologist of at least 55 min about the offense committed, the driving culture and responsibility on the road, and practical driving session with a driving instructor. If the right to drive has been withdrawn for a year or more, the driver has to retake both the theoretical and the practical driving test. Additional driver training may also be provided to novice drivers (not having two years of experience) who violate the RTR rules, as young drivers are more prone to errors or unsafe behavior on the road (Šeibokaitė et al. 2020). If these courses are not attended, a 10-year valid driving license is not issued to them.

A number of studies have been carried out in the country to monitor the behavior of road users, as road users specifically are the main perpetrators of road crashes. The irresponsible behavior of drivers, pedestrians, and cyclists, apart from carelessness and negligence, leads to disasters where they are most often affected, but it is too late for many citizens to become aware of the principles of good road behavior. The behavior of 1896 drivers was observed while they were waiting for the green light at signal-controlled intersections in various cities of Lithuania (Bogačionok and Rimkus, 2020). The most commonly encountered extraneous non-driving related activities are talking on and surfing on the phone (16.2% of observed drivers), communication with passengers (11.3%), and smoking (4.9%). In addition, other kinds of extraneous activities have been observed, that is, eating/drinking, checking one's appearance in the mirror, searching for fallen objects, cleaning the cabin, dozing off, throwing of rubbish through the window, using a computer, etc.

Another study observed pedestrian behavior and found that 18.6% of them crossings behave irresponsibly or violate rules at pedestrian (KTTI 2014). The study included a total of 23 h of surveillance of pedestrian crossings in the two largest cities in the country. In unregulated pedestrian crossings, pedestrians usually do not look around properly, are distracted from the traffic or simply cross the street, not at the crossing. The regulated pedestrian crossings are dominated by non-observance of traffic lights as well as inattentiveness and off-crossing.

Special attention needs to be paid to professional drivers as they spend their day on the road while carrying freight or large groups of passengers. Understandably, their responsibilities, in this case, are higher, so the requirements for the selection of such drivers are also stricter. A study of psycho-physiological characteristics of drivers (reaction time, attention concentration) and the influence of fatigue of these drivers on road crashes was carried out in a public transport company of the capital city of Lithuania, engaged in passenger transport within the city and suburbs (Zaranka et al. 2012). The study found that drivers are most likely to be involved in a road crash on the first day after a day off and that the likelihood of crash increases during the first hour of work and in the middle of the shift when the first signs of fatigue occur. Taking into account the results of the study, the company has applied a special method of selection of drivers based on driving experience, skills and attention keeping ability in accordance with the age group of the driver.

## Second Priority: Safer Roads

The total network of Lithuanian roads reaches 84.5 thousand km. Roads are divided into national (21.2 thousand km) and local roads (63.1 thousand km), depending on the traffic permeability of vehicles and their socioeconomic importance. The network of roads assigned to the streets is 7.2 thousand km (LRA 2019).

Lithuania is a transit country in terms of its geographical location and share of gross domestic product. Back in 1994, the European transport ministers at a

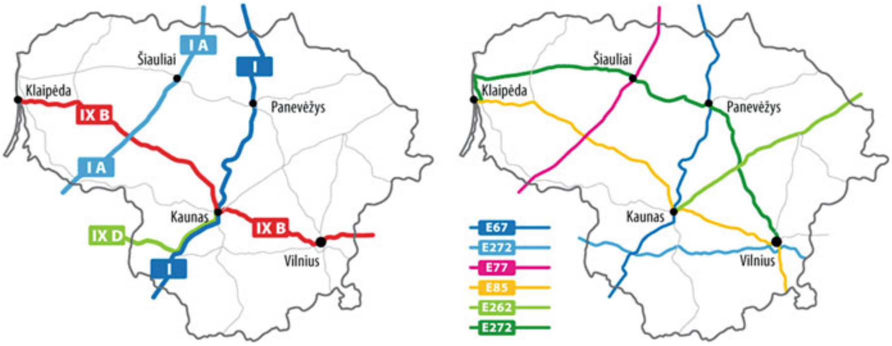


**Fig. 11** Interstate road network crossing Lithuania: branches of the *Trans European Network* corridor (left); highways of European significance (right)

conference in Crete identified two Trans European Network corridors crossing Lithuania's territory (Fig. 11a). In addition, there are six highways of European significance in the country (Fig. 11b). Such interstate road infrastructure, the geographical location of the country, and the state policy implemented make land transport a significant contribution to the national economy. In accordance with the Lithuanian Department of Statistics, the state receives about 13–17% of the gross domestic product of the country due to cargo transportation. Therefore, Lithuania can rightly be called a transit state. In Lithuania, in the area of export services, road transport accounts for the largest proportion, 28.7% of services, compared to other modes of transport (railways, air and sea). The majority of cargo, 62.3%, is also carried by Lithuanian motorways (LRA 2015).

Despite the apparent benefits of the transport business, heavy traffic of vehicles carrying goods is causing a significant part of total crashes, which requires more attention and additional investment in ensuring the safety of the road infrastructure. Heavy vehicle drivers are responsible for about 25 road fatalities of road users each year in the country, which corresponds to about 14% all fatalities in the country's roads.

From the point of view of road safety, it is important that professional drivers working in the field of transport comply with the requirements in terms of road safety that apply to them. For this purpose, the country provides for automatic preliminary law enforcement of driving and rest regime and heavy and large-sized vehicles. The integration of vehicle number plates and data validation system in the road infrastructure requires automatic traffic law enforcement of the driving and resting mode. Thus, drivers will try not to violate the prescribed driving and resting regime, and it has a direct connection with driving and traffic safety. An automated traffic law enforcement system would also allow heavy and large-sized vehicles to be controlled, so drivers and logistics companies will try to stay within the maximum weight and size limits.

In its strategy, Lithuania has set a target that the share of driving and rest violations classified as very serious and severe of the number of drivers checked should be reduced from 10% in 2016 to 5% in 2025 and up to 1% in 2030. The reduction of the share of noncompliant vehicles in terms of securing goods and carriage of dangerous goods by 2030 is expected to be 10 and 5 times, respectively.

The ratio of serious and very serious violations detected and rectified, to road vehicles when the allowed dimensions, gross mass and axle loads are exceeded without authorization, should increase from 10% to all recorded violations of this type (2016) to 50% (2025) and up to 80% in 2030. The objective of this indicator is to limit and eventually fully stop the participation in general traffic of vehicles which, when exceeding the maximum permissible parameters, pose a severe traffic safety hazard and have a significant negative impact on the environment or serious property damage.

Once the state road crash trends are identified, apart from the measures aimed at the education, traffic law enforcement and responsibility of road users, separate measures should be applied in parallel to other priority areas: streets and roads, vehicles, efficient post-crash assistance, sustainable interaction with other modes of transport.

The streets and roads we travel on every day also make a significant contribution to our security. Every year, over 250 high crash risk sections are reconstructed on state roads with various measures to improve the traffic safety (roundabouts, barriers, city gates, safety islands, directional lighting, speed controls, etc.). Due to consistent activities, the number of high risks sites on state roads has been reduced from 280 to 37 in 7 years (Fig. 12).

One of the causes of road fatalities is the poor condition of some roads as well as the lack of modern road safety and traffic control measures (Government of the Republic of Lithuania 2013). Thirty-two percent of Lithuanian roads are in poor or very poor condition, and the existing road pavement reconstruction volume (1.6% of the total road length in 2009) is five times lower than optimal. EU Directive 2008/96/EC provides that measures to improve road safety shall be implemented throughout the road infrastructure network.

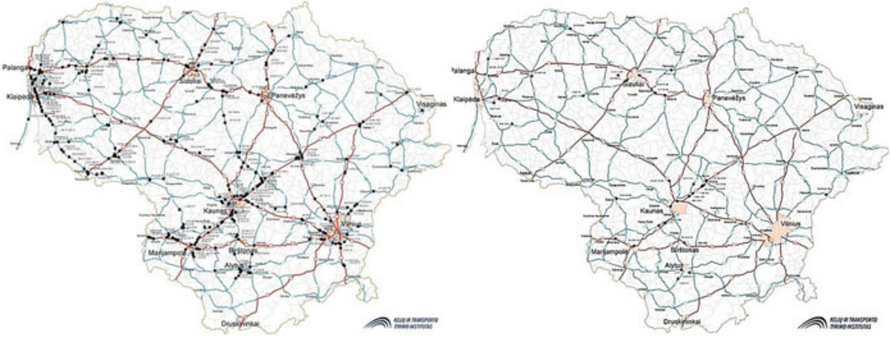


**Fig. 12** Maps of high risks sites on national trunk roads and state roads 2007 (left) and 2015 (right). (Source: Transport Competence Agency)

Despite the decreasing number of high crash risk sections on the country's roads, it is imperative that **the road infrastructure is managed using advanced technology and interstate road safety standards and provides the reliable information needed to improve road safety**. The main tasks applied for this are:

- Continuous road maintenance and implementation of engineering safety improvement measures and evaluation of their effectiveness
- Advanced traffic safety management
- Collection and analysis of advanced crash information using advanced techniques

Lack of information about the circumstances is noticed during the analysis of road crashes in Lithuania. The specific information covers incorrectly specified exact location of an accident, insufficient information about specifics of local infrastructure, insufficient information about seat belts, child seats or helmets usage and airbags deployment, poor information on human injuries, inaccurate information on the type of the crash. Thorough data about road crash collection will help to identify the root causes and select, as well as implement specific measures for avoidance of fatal crashes.

The detailed measures, anticipated effects, and evaluation indicators to address the problems related to the management of road infrastructure are presented in Table 7.

The Valletta Declaration (No 9994/17 TRANS 252), approved by the Council of the European Union on 8 June 2017, states that Member States undertake, in their efforts to achieve the objective of reducing the number of fatalities up to 2020, to continue work together toward: (i) reduction of the number of serious injuries in road crashes; and (ii) by 2018 at the latest start providing reliable and comparable data using a common definition based on the MAIS 3+ injury classification (Maximum Abbreviated Injury Scale of three or more (MAIS3 +)).

In order to reduce the number of fatalities among pedestrians and cyclists and to reduce the number of crashes caused by overtaking, it is necessary **to develop the road infrastructure that improves road safety and mobility by**:

- Reconstruction of unsafe crossings so that they meet their requirements, extension of pedestrian and cycle paths (including cycle lanes), an adaptation of road infrastructure to persons with disabilities, development of road infrastructure ensuring the safer movement of animals when crossing the road network, reconstruction of dangerous intersections, removal of unprotected left turns on the highways
- Installing and developing intelligent transport systems (ITS) on the roads of national importance for ensuring traffic safety (prevention of unauthorized overtaking, etc.)

Table 8 shows the exhaustive measures, expected effects, and evaluation indicators to address the problems related to the development of road infrastructure to improve road safety and mobility.

**Table 7** Implementation of advanced technology in road infrastructure management. (Adapted from National Road... 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Advanced road safety management | | |
| Implementing a road infrastructure management system | The created road infrastructure system will allow more efficient planning of investments, need and use of funds for improving road safety, prioritization of repairs and other work | The road infrastructure of national importance is managed using a unified information system |
| To carry out the road safety impact assessments and road safety audits for street construction, reconstruction, and major repair projects | All new street construction, reconstruction, and major repair projects will be evaluated in accordance with a set methodology for safe traffic. The objective is to make them safer for all road users when constructing or redesigning objects | Road safety impact assessment and traffic safety audits are carried out for street construction, reconstruction, and major repair projects, 100% in 10 largest cities in Lithuania |
| Establish the procedures for training and certification of road safety auditors | More specialists able to carry out road infrastructure safety audits will be trained to ensure that road and street construction, reconstruction, and major repair projects meet the road safety requirements | Traffic safety auditors shall be trained and certified in accordance with the procedure established by the competent authority of Lithuania |
| To set requirements for adaptation of roads and their elements to people with special needs | The newly constructed or reconstructed road and street infrastructure will be adapted to people with special needs and will ensure their safe participation in traffic | Road reconstruction or significant repair projects are carried out in accordance with the requirements for the adaptation of motorways and their elements to people with special needs |
| Perform street safety inspections | Regular inspections are a necessary tool to prevent intrinsic hazards, and therefore safety inspections would be carried out on the operating streets to identify aspects related to street safety and to prevent crashes. | A safety inspection of the streets of the ten largest cities of the country was carried out for 100% |
| Prepare maps of high risks road sites in the cities | The safety of existing streets must be increased by directing investments to the most crash-prone sections and those with the highest crash reduction potential. Drivers must be made aware of high-traffic road sections in | Maps of high risks road sites have been prepared for the ten largest cities of the country, and plans for elimination of high risks sites have been approved |

(continued)

**Table 7** (continued)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| | order to change their behavior and to enforce road traffic rules, in particular as regards speed limits | |
| Collecting and investigating detailed information of road crashes | | |
| As research is an essential tool for improving road safety, it is provided to carry out an in-depth analysis of serious collisions involving road users | The development and demonstration of components, tools, and methods and the dissemination of research results play an essential role in improving the safety of road infrastructure. The specific crash causes involving road users will be investigated, and remedies identified to remove these causes | A new classification of crash causes affecting road users has been prepared |
| To update the methodology of crash data collection using advanced solutions | The update of the methodology will allow collecting more information on the number of road users who have been injured, allowing for more accurate modeling of the management of the risks involved | A new methodology has been adopted |
| To establish an information system for the analysis of data on road crashes and for monitoring the implementation of road safety measures, which can be accessed by all interested authorities | More accurate crash information will be collected, which will enable for more precise identification of the circumstances of the crash and will allow this data to be used in selecting measures to prevent other potential accidents<br>Responsible authorities would have access to primary crash data and could analyze their causes. The use of IS would result in the preparation of maps of high risks sites and monitoring the results of implemented traffic safety measures | A computer-based traffic data filling application is used to collect crash data, 80% of all crashes affecting road users<br>Competent authorities have access to the updated database of accidents affecting road users |
| Categorize injuries sustained in road crashes as minor and severe in accordance with the MAIS3+ method | Uniform monitoring of statistics on traffic-injured persons to allow for a more efficient selection of traffic safety measures, is in place | A new methodology for classifying injuries sustained in road crashes as mild and severe in accordance with MAIS3+ |

**Table 8** Development of road infrastructure to improve road safety and mobility. (Adapted from National Road... 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Increasing road and street safety | | |
| Increase the length of fences against wildlife, the number of wildlife crossings and other roadside protection measures | The aim is to reduce the number of encounters with large and small species of wildlife | Road sections with the introduction of these changes shall 80% less of road crashes involving injuries or fatalities due to collision with wild animals |
| To reconstruct trunk roads with the most intensive (transit) traffic | Significant reduction in the number of road crashes is expected due to the reconstruction of highways with the highest traffic density | After the reconstruction of trunk roads, the number of road crashes in which injured or killed road users are reduced by 50% |
| To increase the overall length of roads with dividing strip, pedestrian and bicycle trails, illuminated roads, reconstruct unsafe intersections, increase the length of safe sidewalks | These measures are aimed at improving road safety and providing the right conditions for safe cycling | 50% less of road crashes involving injuries or fatalities occur on the road sections where these changes are implemented |
| To develop the installation of the bike and ride stops and bike-sharing systems in the cities | These measures are intended to encourage and facilitate cycling | Equipped system of bike and ride stops and bike-sharing in six cities |
| To remove or modify any existing pedestrian crossings that do not comply with the rules for the organization of pedestrian crossing through roads and streets | Potentially dangerous pedestrian crossings will be eliminated or converted into safe areas | 80% of crossings comply with the requirements of the rules for the organization of pedestrian crossing through roads and streets. In such crossings, 50% less of pedestrians are killed or injured compared to the situation before the conversion of crossings |
| To carry out the maintenance of roads of national importance at a higher level | Road safety conditions will be insured, and roads will meet the security requirements in response to the changing climatic conditions or obstacles on the road | To decrease the number of crashes involving road users on slippery roads on state roads by 20% |
| To develop a road and weather information system | Road users will be provided with more accurate information on road traffic conditions. Getting more information about metrological conditions will make road maintenance more efficient | Development of a network of metrological stops by 15% annually |

(continued)

**Table 8** (continued)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| To increase the efficiency of lighting on roads of national importance | Road sections will be better lit | Reduction of accidents affecting road users in the road sections where road lighting has been replaced by more efficient lighting, by 10% |
| Deployment and development of road safety improving the its | | |
| Implementing a multifunctional violation control system on state roads | This system will allow controlling the weight, dimensions, speed of passing vehicles or their combinations, checking whether the vehicles have valid roadworthiness tests, compulsory motor third-party liability insurance, and registration data. In addition, the information obtained is required for traffic management on motorways | For road sections with a multifunctional violation control system implemented, no violations of RTR are detected in the passing 90% of vehicles |
| To implement an average speed control system on state roads | The introduction of an average speed control system aims to keep vehicles within the set speed limits<br>Sanctions will be applied to drivers who exceed the established speed limit on the road section | On-road sections fitted with an average speed control system, the percentage of motor vehicles exceeding the speed limit above 20 km/h does not exceed 2% of the total number of passing motor vehicles |
| To develop a network of stationary speed meters on state roads by expanding their functionality | By increasing the number of fixed speed meters on the roads by more than three times and supplementing their functions, to record the leaving vehicles exceeding the set permitted speed, it is expected to significantly reduce the number of speeding vehicles on dangerous road sections | On-road sections with fixed speedometers, the percentage of motor vehicles exceeding the speed limit above 20 km/h shall not exceed 2% of the total number of passing motor vehicles |
| To deploy a dynamic safety speed management system on state roads (road signs with variable information) | The introduction of a dynamic safe speed management system will allow for rapid response to metrological conditions or obstacles on the road | 50% fewer accidents due to failures to select safe speed occur on the road sections with a dynamic safe speed management system installed |

After implementing measures to improve the management of road infrastructure in the long term it is expected that in Lithuania from 2018 to 2030:

- The number of pedestrian fatalities should drop to 34 (−50%)
- The number of cyclists killed will decrease to 8 (−50%).
- The number of road crashes involving animals on state roads will drop to 5 (−83%).
- The number of collisions when driving to the opposite lane should reduce to 80 (−66%).
- The number of road crashes affecting road users when the motor vehicle is driven off the road will fall to 394 (−30%).
- The length of the pedestrian and (or) bicycle trail network on state roads will increase to 1418 km (+ 18%).

The majority of measures to improve street and road infrastructure need to be adapted to the specific safety concerns and needs and habits of different groups of road users. A holistic assessment of the situation leads to a long-term and sustainable positive outcome. One example of this was the permission for cyclists to drive on pedestrian sidewalks, given the needs and specific habits of road users, where there is no bicycle lane or bike lane nearby and without endangering pedestrians, introduced in 2014. Nonetheless, often, if the interests of some road users are considered, then the interests of other users are undermined. Improving pedestrian safety by the reduction of the speed of movement of motorists, flow capacity or driving comfort, is a typical example. A change to the RTR has been introduced in the country, obliging drivers to park a vehicle at least 5 m behind a pedestrian crossing if there is one lane in each direction on the street, this way, not obstructing the visibility of pedestrian crossing to other drivers.

Given that the number of road crashes involving pedestrians in their crossings has increased over several years (2014–2016), the rules for the organization of pedestrian crossings on roads and streets were adopted in 2017. These rules prescribe the conditions, requirements, and restrictions for the installation of pedestrian crossings in the territory of the Republic of Lithuania. It is intended that the provisions of these rules should apply to the construction or reconstruction of roads and streets and major or ordinary repairs to roads and streets. The rules will also encourage municipalities to improve the safety of existing pedestrian crossings in the coming years. The approved rules set requirements for pedestrian crossings equipped on state roads can also be applied to local roads and streets maintained by municipalities. The rules establish the general conditions for the installation of pedestrian crossings and the requirements for engineering measures to ensure safe traffic. They are obligatory for newly constructed or reconstructed pedestrian crossings on state roads, recommended for previously installed pedestrian crossings on all roads (streets) of local importance. Municipalities reconstruct dangerous pedestrian crossings in accordance with the terms and conditions of the rules in order to improve the level of safe traffic for hazardous pedestrian crossings and to ensure pedestrian safety (Fig. 13). The rules for the installation of pedestrian crossings have been developed,

**Fig. 13** Examples of reconstructed pedestrian crossings in Lithuanian cities

taking into account the acceptable practices of foreign countries. The rules are characterized by the fact that, depending on the traffic intensity of pedestrians and cars, they clearly indicate when:

- Engineered traffic safety measures are installed for the safe crossing of the road (street)
- pedestrian crossings are installed
- Traffic light-controlled pedestrian crossings are installed
- Underground pedestrian crossings or pedestrian crossings above the road (street) are installed

The rules are designed to maximize pedestrian safety on the roads (streets). As an example, no pedestrian crossings can be on the roads (streets) where driving speed is above 50 km/h. Road design in those sections should be changed or pedestrian crossing removed. The rules also set visibility requirements for pedestrian crossings to be installed so that both pedestrians and drivers can notice each other in due time. The indicated engineering traffic safety measures are applied together with pedestrian crossings.

In 2018, the Lithuanian Road Administration (LRA) under the Ministry of Transport and Communications conducted a study that found that as many as 1,721 pedestrian crossings from 1,949 on national state roads were unsafe (LRA 2018). It is estimated that almost 95% of pedestrian crossings are not illuminated by directional lighting, 29% crossings have no raised islands or dividing sections, thereby requiring pedestrians to cross a driveway wider than 8.5 m. Almost 20% crossings have no sidewalks, pedestrian and (or) bicycle paths, 18% of the crossings have no lighting at all, and adequate visibility is not ensured in them. More than 10% of crossings have no raised islands or dividing sections, although pedestrians have to cross more than two traffic lanes. The majority of such pedestrian crossings are being reconstructed, while the remaining part, where the speed limit is higher than 50 km/h and in other urban areas, will be eliminated.

Several priorities are set to attain ambitious road crashes reduction tasks in Lithuania, and one of them is modern information technologies. The objective of the priorities is to improve the process of collecting and presenting traffic data and implementing and developing Intelligent Transport Systems (ITS) in road infrastructure and vehicles (Jarašūnienė and Batarlienė 2020). After the deployment of the intelligent transport systems, Lithuania moved closer to the Western European countries in terms of the level of information traffic systems. Now road users, when planning their trips (and on the road), can quickly obtain traffic information or information on weather conditions and road surface conditions (Fig. 14), road repairs, their duration and detours, natural traffic restrictions, dangerous obstacles, and traffic disruptions (LRA 2015).

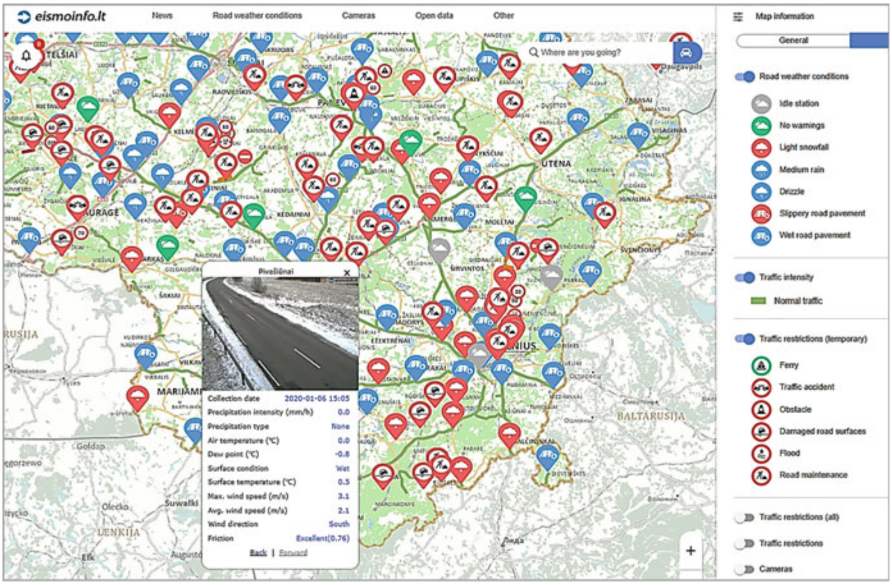


**Fig. 14** Image from the website, providing drivers with instant information on the state of the country's roads, meteorological conditions, repairs, etc. (http://eismoinfo.lt)

Despite the country's progress, there are also difficulties or delays in the work. The existing trans-European transport network infrastructure in Lithuania does not meet some of the requirements: lack of efficient interconnections, unresolved some of the bottlenecks, incomplete adaptation of intelligent transport systems ITS, the current state of infrastructure is unable to meet the increasing road safety, and environmental requirements (Government of the Republic of Lithuania 2013). These shortcomings hinder the smooth and safe mobility of passengers and freight. Inefficient interconnection between different modes of transport and between the main and general transport network elements does not ensure sufficient interoperability between different transport modes. This reduces the cost of passenger and freight transport and increases the flexibility of transport services, but also contributes to reducing the negative environmental impact of the transport system.

### Third Priority: Safer Vehicles

The average age of the country's passenger vehicle fleet in 2018 was as high as 14.4 years, while new cars registered for the first time made up only 16%, although this rate started to increase in 2019 (Source: VĮ Regitra). The big age of the vehicle fleet means that only every second passenger vehicle passes the mandatory roadworthiness test from the first attempt (Source: Lithuanian Association of Technical Inspection Companies Transeksta). Most of the deficiencies include unadjusted dipped-beam headlamps (13.3%) and malfunctioning suspension elements (11.9%). It is found that vehicle defects relating to lighting and signaling equipment have a weaker correlation with accident rates (coefficient of correlation 0.23) than brake failure (0.49) or tire failure (0.38) (Bureika et al. 2012). However, taking into account the natural conditions of Lithuania when the dark time predominates in October to March, the importance of vehicle lighting equipment for road safety is much higher. The target is that the assurance of good technical condition of the vehicle must be the responsibility of each driver.

Given the age of the country's fleet of vehicles and the prevailing technical shortcomings, it is crucial **to ensure that only safe means of transport are used on the roads of the country and to reduce the number of crashes caused by technically unsound vehicles**.

The detailed measures for achieving these objectives, the expected effects and evaluation indicators are presented in Table 9.

After the implementation of safe vehicles for road traffic in the long term it is expected that in Lithuania by 2030:

- The proportion of noncompliant vehicles banned from operating will be reduced to 1% (from 5% in 2016)
- The average age of passenger cars registered in Lithuania will decrease to 10 years (from 15 in 2016)

**Table 9** Implementation of safe vehicles on the roads. (Adapted from National Road... 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| More efficient law enforcement of the conformity of road vehicles with the specified technical requirements | | |
| A more thorough inspection of requirements of vehicles should be applied during roadworthiness tests where the deficiencies of vehicles pose an immediate and imminent danger to road safety or which have a negative impact on the environment during a roadworthiness test | As vehicle requirements change, deficiencies that pose a direct threat to road safety are more clearly identified; therefore, targeted inspections can more accurately identify deficiencies, and the equipment used will allow for a more reliable system performance checks | Vehicle requirements are tested using equipment and the latest technology |
| Aim to Reduce the average age of the passenger car fleet | | |
| To prepare a study on cost-effective ways to promote the purchase of safer and greener cars | Measures will be selected to encourage the purchase of safer and greener vehicles | An implementation plan for the measures has been approved |
| State support for residents to purchase a newer vehicle and disposal of the old vehicle | Newer vehicles will be purchased and old unsafe and polluting vehicles will be discarded | Reduction of the age of the fleet of passenger cars to 10 years |
| Renewal of local (urban and suburban) public transport fleet with green vehicles | Local public transport will be safer and greener | Increase in the share of public transport travel compared to 2016, by 5% |
| Ensure that only safe vehicles are returned to traffic after road crashes | | |
| Establishing precise requirements for safe vehicle operation and the restriction of the use of unsafe vehicles | The participation of unsafe vehicles in public traffic will be severely restricted | Reduced number of unsafe vehicles in public traffic |

Newer cars on the country's roads mean not only their better technical condition, which correlates with the rates of accidents caused by vehicles state, but they also have more active safety systems (wheel-antilock braking, stability, automatic emergency braking, lane-keeping, blind zone monitoring, driver attention tracking) (Jarašūnienė and Batarlienė 2020). Newer vehicles also have advanced passive safety, reducing the impact of a road crash on the driver, passengers, and vulnerable road users. Although under normal driving conditions, active safety systems often do not give drivers too much confidence or the expected effect, their increasing use in the long term contributes to the overall improvement of safety and the positive assessment by drivers (Broughton and Baughan 2002; Reagan et al. 2018). From the current advanced driver assistance systems (ADAS), automotive manufacturers distinguish the automatic emergency braking system as most contributing to the reduction of accident rates. However, the reliability of these systems still depends to a large extent on the technology used (obstacle detection by radars or cameras), environmental conditions (road surface adhesion, foreign objects), and driving circumstances (driving speed and nature of the obstacle movement). Taking this into account, in Lithuania in 2018–2019, the research team of Vilnius Gediminas Technical University (VTGU) conducted research of new cars with the emergency braking system. Of the 51 vehicles tested (23 vehicles from different manufacturers), 24 vehicles driving at 30 km/h stopped on time before the stationary obstacle, 8 cars stopped incompletely, and the remaining 19 did not significantly reduce their speed. This result indicates that electronic braking assistants are still merely auxiliary steering systems and that drivers need to rely entirely on their driving skills and leave the operation of ADAS systems only for emergencies. A similar performance of the system, not exceeding 59% for the front-to-rear crash, was shown in a study carried out by the Insurance Institute for Highway Safety (Cicchino 2017).

### Fourth Priority: More Efficient Rescue Assistance After a Road Crash

One has to admit that human errors cannot be avoided both by the road users or by specialists who are responsible for ensuring their safety. Therefore, even in the event of a road crash, it is imperative **to seek effective assistance from rescue teams**. Depending on the event, post-crash rescue teams in Lithuania consist of police, fire and rescue services, medical, and road maintenance personnel. Thanks to the Emergency Response Centre, which already operates in the country, the responsible call reaches rescue teams smoothly, and they can respond quickly and promptly to the call. Nonetheless, there are cases where emergency services have to perform extra tasks that are outside their scope of operation. For example, at night or in remote areas, police officers or rescuers have to clean the scene of the crash, and police officers are delayed by the owner of the vehicle or cargo that is not arriving or arriving late to the scene (KTTI 2017). Rescue services also require improved financial provision for rescue measures and materials. The detailed measures, expected effects, and evaluation indicators for achieving this objective are presented in Table 10.

## Rail Transport and Road Traffic Safety

The European Union Railway Safety Report, published by the European Railway Agency in 2014 and presented to the European Commission, provides a significant threat to society posed by the railway system of the Republic of Lithuania as the highest among 28 Member States of the European Union. In the period 2010–2016, there were 180 major rail traffic crashes, with 129 persons killed and 61 seriously injured. The highest number of victims of rail crashes is bystanders (persons not entitled to be in a dangerous railway area), level crossing users (persons crossing the railway line by any means of transport or by foot on the railway crossing), and crossing users (persons crossing the railway line by foot at the level crossing). A minority of the victims are employees of railway companies (Fig. 15).

**Table 10** Implementation of efficient rescue assistance. (Adapted from National Road. . . 2020)

| Measure | Expected effect | Assessment indicator |
|---|---|---|
| Enhanced collaboration between rescue teams | | |
| Number of joint exercises for rescue services | Following the implementation of the measure, the actions of the rescue services involved in the removal of crashes will be better coordinated | Different scenarios for the joint exercises of the fire brigade, ambulance, emergency response center, police every year |
| Improving the qualifications of rescue team specialists | | |
| Additional practical driving training for rescue team drivers | After implementing this measure, rescue team drivers will continually improve the practical driving skills needed to perform their functions safely | Mandatory training of rescue crew drivers on reduced adhesion surfaces has been introduced |
| Interoperability of information systems used by emergency services, general assistance centre, police, and traffic management centre | | |
| Accept e-call system calls | In the event of an accident, a signal will be sent immediately to the General Assistance Centre | The crash is reported to the medical personnel within 2 min after receiving a call through the e-call system |
| Improving the issue of driver health certificates, the authority issuing the driving licenses shall receive data electronically on the fitness to drive | There will be no possibility of acquiring a driving license without complying with the health requirements for drivers (health condition and psycho-physiological abilities must be appropriate for driving in the relevant category (s) of vehicles) | Information on the fitness of a person in terms of health and psycho-physiological abilities to drive a vehicle of the appropriate category (s) shall be transmitted electronically to the licensing authority, 100% |
| Transmission of electronic data to the licensing authority in the event of a change in the health condition and the person is unable to drive a motor vehicle | Failure of the driver to meet the prescribed medical requirements (i.e., health condition and psycho-physiological abilities to drive the relevant category (-ies) of vehicles) shall result in immediate restriction of the ability to drive, etc. | When a medical institution determines that a person's health condition and psycho-physiological abilities are unfit to drive a vehicle of the relevant category (s), the information shall be transferred to the the authority managing the driving license register electronically, 100% |

The main types of violations which result in fatalities or injuries in road crashes are:

- Users of level crossings enter the level crossing under the prohibiting traffic lights when the barrier is lowered or starts to fall
- Bypass other vehicles that have stopped before the level crossing to pass the train
- Arbitrarily raise or circumvent a barrier

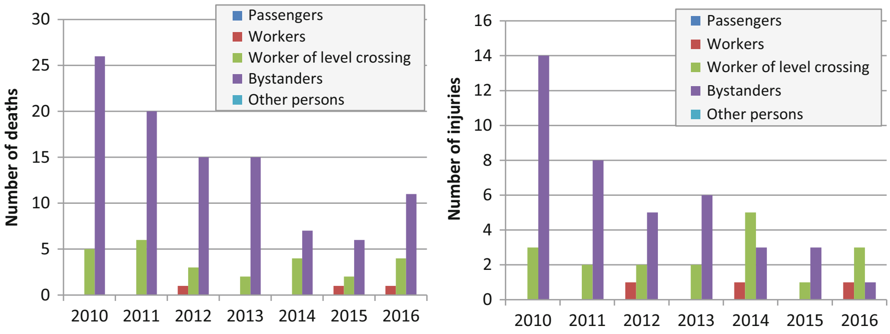


**Fig. 15** Railway crashes in 2010–2016. (Source: Lithuanian Ministry of Transport and Communications)

- Enter the crossing area if there is an obstacle behind it
- Deliberately transports unprepared agricultural, road, construction, and other machinery through the crossing

These violations are due to the following reasons:

- Vehicle breakdowns
- Poor visibility due to poor weather conditions and (or) poorly designed road infrastructure
- No sense of responsibility for one's actions (no perception of the level of danger, a habit of breaking traffic rules at level crossings, not being expected to be punished)
- Lack of education and effective information campaign on safe behavior at a level crossing
- Drivers rush/late
- Users of level crossings can physically violate the road traffic regulations (lack of proper railway infrastructure or inconvenience to use it)
- Drivers are tired of waiting at the crossing
- Persons crossing the railway are intoxicated with alcohol or other psychoactive substances
- Because of convenience and time-saving, and due to poor road infrastructure, pedestrians cross the railway at unsuitable locations

The crossing of motorways with the infrastructure of other land vehicles raises **an important need for safer level crossings and safer rail infrastructure**. In some cases, a level crossing is not possible without direct interaction with road vehicles or pedestrians (one level) and a huge difference in mass and speed often lead to the tragic consequences of accidents. As some part of rail accidents is related to roads, the causes and suggested measures are analyzed in the context of road traffic safety. Therefore the main measures to increase safety are: automatic level crossing violation control, reconstruction of level crossings and railway stations, an update of rules for installation and use of level crossings with basic safety standards, implementation of means of information, education on safe behavior in the dangerous railway area for different social groups, in-depth analysis of rail crashes involving road users. After the implementation of railway transport safety measures in the long term, Lithuania is expected to have zero fatalities in the collisions at level crossings in Lithuania by 2030.

Some pedestrians (especially children) are not sufficiently familiar with the basic rules and regulations applicable to road and rail traffic – do not recognize road signs, ignore traffic lights, believing that they are intended for cars. Others are aware of wrongdoing but are not aware of the potential consequences of their behavior that endanger the health and well-being of themselves and others. Other persons (railway employees or suicides) injured or killed in rail crashes are not related to a road safety system.

## Conclusions

Three road safety programs before current Vision Zero have been carried out in Lithuania since the country's independence in 1990. While all road safety programs were aimed at reducing road crashes, only the period of 2007–2011 registered significant achievements in the reduction (more than twice) of fatalities and injuries. Nevertheless, long-term problems of violation of traffic rules and safe driving principles, faulty road safety systems design and ignorant road user behavior remained. A new road safety strategy with the vision to achieve zero fatalities was introduced emphasizing the improvement of road infrastructure, stricter sanctions for offenders of traffic rules, responsibilities and cooperation between institutions and organizations in activities, law enforcement, and education. Specific measures are detailed and targeted at speeding, intoxicated road users, unauthorized use of mobile devices while driving, inappropriate use of reflective elements, seat belt and child seat use, as well as the development of road infrastructure including advanced technologies and its management, implementation of safe vehicles, more efficient rescue assistance after a road crash, and safer level crossings and rail infrastructure. It is expected that purposeful and consistent work will lead to a reduction of 50% in road transport fatalities by 2030 compared to 2018.

The Lithuanian government, civil society and other public, private, academic, and social institutions are committed toward Vision Zero by doing as much as possible in the effort of improving the safety situation in our roads as soon as possible.

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# Vision Zero in EU Policy: An NGO Perspective

14

Ellen Townsend and Antonio Avenoso

## Contents



E. Townsend · A. Avenoso (✉)
ETSC, Brussels Region, Belgium
e-mail: ellen.townsend@etsc.eu; antonio.avenoso@etsc.eu



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**Abstract**

This chapter documents the roots of Vision Zero in EU road safety policymaking and is written from the perspective of the European Transport Safety Council, an NGO that has been deeply engaged in the topic for more than 25 years, from the very beginning of EU road safety policy in the mid-1980s to its first adoption in 2011 and on to the present day. The chapter shows that the Vision Zero approach is now integrated into the new EU road safety strategy. The presence of elements of Vision Zero during the different timeframes is presented. These include ethics, shared responsibility, the philosophy of building a system which allows for error and, finally, creating a mechanism for change. The current EU road safety strategy, which adopts these elements, is reviewed in more detail. More recent implementation is illustrated by references to Vision Zero within two recent, important pieces of road safety legislation, on infrastructure and vehicle safety.

This chapter is written by ETSC and based on the organization's interest and key role in the discussions. It refers to EU official documents going back to 1984, ETSC's own reports and the institutional experience of ETSC and of the two authors. Despite every effort being made to be as objective as possible, the chapter is written from the perspectives of two active participants in the discussions and is therefore not a truly independent account. However, it is hoped that the material presented is useful nonetheless.

**Keywords**

European Union · Road Safety · Vision Zero · European Parliament · European Transport Safety Council · Target · Strategy

## Introduction

This chapter documents the roots of Vision Zero in EU road safety policymaking, from the very beginning of EU road safety policy in the mid-1980s to its first adoption in 2011 and on to the present day. The chapter shows that the Vision Zero approach is now integrated into the new EU road safety strategy. The presence of elements of Vision Zero during the different timeframes is presented. These include ethics, shared responsibility, the philosophy of building a system which allows for error and, finally, creating a mechanism for change. The current EU road safety strategy, which adopts these elements, is reviewed in more detail. More recent implementation is illustrated by references to Vision Zero within two recent, important pieces of road safety legislation, on infrastructure and vehicle safety.

Written by ETSC, thus, the perspective is based on EU official documents and ETSC's own published documents from 1984 which predate the personal experiences of the two ETSC authors, to present day. As this is written by authors who were in part influencing the process of adopting and implementing Vision Zero in Europe, this impacts on the views expressed in the chapter.

This chapter will start with a definition of Vision Zero; this section of this chapter is a summarized extract of a text entitled *Vision Zero*: *from Concept to Action* published by the Swedish Road Administration in 1999 and cited in the important report by the OECD/ITF entitled "Towards Zero: Ambitious Road Safety Targets and the Safe System Approach" (Swedish Road Administration in OECD/ITF (2008)). The aim is to frame the entire chapter on EU policy with a clear definition.

## Sweden's Vision Zero: Not Just Zero Fatalities and Zero Serious Injuries

Recognizing that the road transport system is one of the most dangerous technical systems humanity has created, the elected members of the Swedish Parliament in autumn 1997 adopted a new traffic safety policy, known as "Vision Zero." This new policy expresses a new long-term goal and is based on four elements: *ethics*, *responsibility*, *a philosophy of safety* and *creating mechanisms for change* (Swedish Road Administration in OECD/ITF (2008)).

Human life and health are paramount ethical considerations. According to Vision Zero, life and health should not be allowed to be traded off against the benefits of the road transport system, such as mobility. Rather than placing responsibility for crashes and injuries on the individual road user, the responsibility under Vision Zero is shared between the providers of the system and the road users. The road user remains responsible for following basic rules, such as obeying speed limits and not driving while under the influence of alcohol. The system designers and enforcers – such as those providing the road infrastructure, the car-making industry and the police – are responsible for the functioning of the system. In the event that road users make errors or even fail to follow the rules, the responsibility reverts to the system designers to ensure that these failings do not result in death or serious injuries.

## Vision Zero Philosophy

The Vision Zero philosophy is based on two premises: human beings make errors, and there is a critical human body limit beyond which survival and recovery from an injury are not possible. The safety philosophy recognizes that a system that combines human beings with fast-moving, heavy machines will be very unstable, and a human tragedy can occur if a driver loses control for just a fraction of a second.

The road transport system should therefore be able to take account of human failings and absorb errors in such a way as to avoid deaths and serious injuries. Collisions and minor injuries, on the other hand, need to be accepted. The chain of events that leads to a death or disability must be broken, and in a way, that is sustainable, so that over the longer time period loss of health is eliminated. The limiting factor of this system is the human body's tolerance to mechanical force. The components of the road transport system – including road infrastructure, vehicles and systems of restraint – must therefore be designed in such a way that they are linked to each other. The amount of energy in the system must be kept below critical physical limits, by ensuring that speed is restricted.

## Driving Mechanisms for Change

While society as a whole benefits from a safe road transport system in economic terms, Vision Zero relates to the citizen as an individual and his or her right to survive in a complex system. It is therefore the demand from the citizen for survival and health that is the main driving force. In Vision Zero, the providers and enforcers of the road transport system are responsible to citizens and must guarantee their safety in the long term. In so doing, they are necessarily required to cooperate with each other, because simply looking after their own individual components will not produce a safe system.

While Vision Zero does not say that the ambitions on road safety historically have been wrong, the actions that would have to be taken are partly different. The main differences probably can be found within how safety is being promoted; there are also some innovations that will come out as a result of the vision, especially in infrastructure and speed management.

This chapter of the handbook will identify when the different elements of Vision Zero, as defined by Sweden and listed below, started to appear in EU road safety policy and give some examples of Vision Zero philosophy and its practical application.

## The Four Key Elements of Vision Zero

1. Ethics: no trade-off of safety for mobility.
2. Responsibility: shared between road users, authorities and industry.
3. Philosophy of safety: system absorbs errors.
4. Creating mechanisms for change: targets, strategy, governance and adopting measures. (Swedish Road Administration in OECD/ITF (2008))

## EU Decision-Making in Road Safety

This first section of this chapter provides a brief overview of the European Union's policymaking, legislative and regulatory procedures. Right from the start in the mid-1980s, the EU's decision-makers have had a variety of measures at their disposal to improve road safety and start to realize Vision Zero. This short explanation of the procedure is most relevant in understanding how the EU can use the "mechanism for change" element of Vision Zero. EU procedures have evolved since the 1980s. This brief general overview gives an outline of present-day EU decision-making, which builds upon structures and procedures, mostly already in place in the 1980s, when EU road safety policy started to be formulated.

## Policymaking: A Cyclical Process

The EU's policymaking process can best be visualized as a cycle of stages. Legislation finds its origins in commitments made in political declarations or strategies, such as the ones documented in this chapter, or in requirements in existing legislation or lastly in the evaluation of existing measures. After the preparation stage, decision-making stage and implementation stage of the measure, it is evaluated, following which the results may feed into a revision that marks the start of a new cycle.

While the concept of the policymaking process as a cycle will help visualize and understand the sections below, it is important to keep in mind that this concept is a simplification of reality. For example, the cycle's stages might overlap. Another example would be a change of political leadership with the beginning of a new mandate, with a change of political leadership in the European Commission and in the European Parliament following elections which may result in changes to the policy direction.

## The Treaty on the Functioning of the European Union (TFEU)

The Treaty on the Functioning of the European Union (TFEU) updated last in 2009, originally in place as of 1958, together with the 1992 Treaty on the European Union (TEU), is the constitutional basis of the European Union (European Union 2012). It lays down the structure and powers of the EU institutions and sets out the law-making processes, such as the ordinary legislative procedure.

Moreover, it sets out the EU's competences for different policy areas. There are three main types of competences: exclusive competences, shared competences and supporting competences. For policy areas in the exclusive competences, the EU has the sole right to legislate – for example, in the case of the customs union.

For policy areas in the shared competences, the EU has the right to legislate; however, Member States may do so as well on issues where the EU has not legislated. Transport and the internal market are policy areas where the EU shares its competencies with Member States.

Every legislative measure taken by the EU needs to have a legal basis in the TFEU. Most road safety measures have their legal basis in Article 91 TFEU, which allows the EU to adopt measures on the implementation of the common transport policy and which explicitly mentions the improvement of transport safety.

However, this is not always the case. For example, the legal basis for the General Safety Regulation (GSR) is Article 114 TFEU, which allows the EU to adopt measures aimed at the functioning of the internal market. Therefore, although the GSR improves the safety of vehicles, road safety itself is not the legal basis. Instead, the first recital of the GSR explains that it lays down the administrative provisions and technical requirements for the type approval of motor vehicles "with a view to ensuring the proper functioning of the internal market" (European Union 2012). Only as a second point is the level of safety and environmental performance mentioned in the legal text.

## The European Union's Legal Acts

The TFEU also sets out the EU's legal acts. Regulations and directives are the two main legal acts used by the EU. A regulation is a binding EU law that applies directly all across the EU as of its date of entry into force. A directive, on the other hand, is a binding EU law that sets out goals, which every Member State subsequently has to transpose into their own national legislation. The Member States have the freedom to decide how they transpose the directive's goals into their own laws in order to achieve these goals.

## Strategies, Work Programs, Conclusions and Own-Initiative Reports

Nowadays, the European Commission usually sets out its envisaged actions in strategies and work programs, usually per work area or theme including, for example, the most recent EU road safety strategy setting out its own commitment to Vision Zero, as presented in the previous section. Although non-binding and non-legal, these documents provide an outline of the measures and actions the European Commission intends to take in the upcoming few years in order to address certain problems and issues. The documents therefore reflect and give an insight into the policies the European Commission pursues.

Similarly, the Council may adopt "conclusions" on topics to express its vision for an area of EU policy, whereas the European Parliament may adopt own-initiative reports for the same purpose. Both conclusions and own-initiative reports may call on the European Commission to come forward with legislation or regulation on certain topics. They have frequently done so since the mid-1980s in the area of road safety in general and specifically have called, for example, for the adoption of Vision Zero since the late 1990s as illustrated in this chapter.

## The Ordinary Legislative Procedure

The main legislative procedure used in the European Union's decision-making process is the ordinary legislative procedure (OLP), previously also known as the co-decision procedure, and is used for the adoption of regulations and directives (European Union 2012).

The European Commission has the exclusive right to initiate legislation, meaning that only the European Commission is allowed to present a legislative proposal. It can therefore already decide on which policy options are included in the legislative proposal. Once the European Commission presents the proposal, the European Parliament and the Council will separately establish their informal positions on the proposal. They will then together discuss the final text of the legislative act during informal negotiations known as "trilogue negotiations." If an agreement is reached between the two co-legislators, the act will then be formally adopted by both institutions and subsequently published as a new law.

### Implementing Measures

While a new regulation or directive sets out the main requirements, the technical and administrative details of those requirements are subsequently set out in delegated and implementing acts prepared by the European Commission. The importance of delegated and implementing acts should not be underestimated, as their technical requirements will dictate the required minimum (e.g., safety) performance that is expected. In some policy areas, the European Union wishes to harmonize technical standards at a global level, usually to facilitate trade. It may therefore be the case that the legislation or implementing acts refer directly to these international standards or contain the same requirements.

## Roots of Vision Zero in Europe 1984–2000

With this EU policymaking overview in mind, this chapter will now track the development of EU road safety policy with a focus on the roots of Vision Zero.

In 2018, 26,000 people died on European roads. But in the 1980s and early 1990s, when there were fewer vehicles, road transport was much more lethal than today. Sixty thousand died on European roads in 1980; by 1990, the figure was still more than 50,000 (ETSC 2019d).

Road collisions clearly represented a major challenge to European public health and the economy. The Council of Transport Ministers of Member States gave the first real political commitment to road safety in 1984. In 1986, there were some activities within the first ever framework of the European Road Safety Year. The late 1980s saw the first attempts by the European Commission to develop EU legislation on road safety. The European Commission tested the waters for support for a directive to introduce a common low-level drink-driving limit across the EU. In a similar vein, they also considered adopting a directive on "appropriate speed limits" in January 1987 for road safety, pollution and fuel efficiency reasons. Both attempts were not supported by enough Member States. A first package of legislative measures was put forward in 1989 by the European Commission. This was followed by the publication of the "Gerondeau" Report on road safety, prepared by a group of high-level experts (European Commission 1991). One of the first and important pieces of EU road safety legislation to be adopted was the introduction of the legal obligation to wear a seat belt in 1991 (European Council 1991).

The first formal recognition of the need to take more holistic action on road safety at European level came with the Treaty of Maastricht, signed on 7 February 1992 by the then twelve members of the European communities. The treaty, for the first time, made improving transport safety a formal competence of the European institutions (European Union 1997). The White Paper on the Future Development of the Common Transport Policy (European Commission 1992) contained a commitment to adopt a Community Road Safety Action Program proposing an integrated approach based on qualitative targets and the identification of priorities.

The first EU road safety action plan was adopted in 1993, which effectively marks the beginning of an EU policy on road safety, thus indicating the increased political importance attached to the topic. The Transport Council also adopted council conclusions on the new action plan. In the same year, the European Transport Safety Council (ETSC) was founded. It was to be an independent, member-based organization established as a Belgian international non-profit organization. The stage was set for EU action on road safety. Thus, the development of a succession of road safety plans prepared by the European Commission with input from the European Parliament and Council followed, all under the watchful and critical eye of civil society organizations including ETSC. This also paved the way for the eventual adoption of Vision Zero in 2011 nearly 20 years after the first EU Road Safety Action Program.

Following the adoption by the EC of the new road safety plan in 1993, the European Parliament welcomed the plan with a resolution in 1994. In the area of target setting, note that an increasing number of Member States are setting "percentages by which they aim to reduce the number of deaths and injuries on the roads" adding that the European Parliament wanted "to see a 20% reduction in the number of road deaths by the year 2000" (European Parliament 1994).

Early on, ETSC also recognized the need for strategic road safety targets and strategies. An ETSC report, "A Strategic Road Safety Plan for the European Union," was crucial in laying out proposals for the second official road safety program which also came later in 1997 (ETSC 1997b). In the report, ETSC floated the idea of the EU adopting Vision Zero the same year as Sweden: "It has been suggested that it is unethical to accept anything other than a zero casualty target. While the long-term objective can only be the reduction of all fatalities known as the 'zero vision,' the setting of numerical targets acknowledges that this will not happen overnight and that good progress can be achieved by a step-by-step approach." The 1997 EU Action Program developed by the European Commission, with input from the European Parliament and the Council, paved the way for European road safety targets and eventual adoption of Vision Zero, first adopted by the EU in 2001 and renewed in 2011 and 2018.

As mentioned previously, elected members of the Swedish Parliament adopted a new traffic safety policy, known as "Vision Zero" in 1997. Shortly after, Sweden reduced speed limits in densely populated areas, changed the education system for drivers and introduced new standards for work-related road safety and public procurement. ETSC was monitoring the developments in Sweden and in its 1997 annual overview entitled "Visions, Targets and Strategies" reported that "While no time goal is set to achieve the long-term objective of Vision Zero, ETSC believes that the principles laid down in this exciting new strategy indicate that Sweden clearly continues to mean business in its road safety work" (ETSC 1997b).

The same 1997 ETSC annual overview also reported on a debate of the EU ministers at the Council on the Second Road Safety Action Program stating that "It is clear that Vision Zero for EU road safety work as a whole is a long way off. With the EU transport Council of Ministers failing to countenance even a short-term casualty reduction target to demonstrate that political will for effective actions exists, despite the encouragement given by the Dutch EU Presidency" (ETSC 1997b).

In February 1998, the European Parliament adopted a report on the communication from the Commission, "Promoting Road Safety in the EU: The Program for 1997–2001." There was no mention of Vision Zero. However, the MEPs gave their strong support for a target: "The EU should establish a numerical target to reduce the annual deaths from the current level of 45 000 to a maximum of 25,000 by the year 2010." Furthermore, "considers that such a target would provide a stimulus to all parties involved in the promotion and improvement of road safety and would contribute to mobilizing their efforts further."

Setting numerical targets to reduce road deaths and serious injuries is an interim step in realizing the long-term Vision Zero (Swedish Road Administration in OECD/ ITF (2008)).

In sum, the described key elements of Vision Zero were to be found in the early days of EU road safety policy development. ETSC and others were following the adoption of Vision Zero in Sweden with interest. So point 1 on "ethics" was starting to attract interest. The first steps of "creating mechanisms for change" were taking root. The European Parliament and ETSC were calling for the setting of a numerical target and political will by decision-makers. There were the first efforts at adopting EU legislation on road safety.

## 2001–2010: The First Numerical Target to Reduce Road Deaths – Still No Vision Zero

Toward the end of the Second Road Safety Action Program in the year 2000, the Commission published a communication in the form of a progress report on fulfilling the actions of the last program (European Commission 2000). The Council adopted a resolution in 2000 also supporting the "wisdom of setting a target figure for a reduction in the total number of victims on the roads of the Community" (European Council Resolution 2000). This was significant, as the European Commission had the support of the Council to proceed and adopt a target. ETSC continued to call for "a proposal for an EU numerical target to reduce deaths to a maximum of 25,000 annually by the year 2010" (ETSC 2000). Finally, after years of work, the first EU target to reduce road deaths was adopted by the European Commission in 2001 in its White Paper. "In the battle for road safety, the European Union needs to set itself an ambitious goal to reduce the number of people killed between 2000 and 2010. The Commission plans to marshal efforts around the target of halving the number of road deaths over that period" (European Commission 2001). Thus by 2001, one of the key framework elements of Vision Zero, "creating mechanisms for change," was put in place: Europe's first target to reduce road deaths.

ETSC welcomed the new road safety target but with a note of caution: "ETSC welcomes the fact that the White Paper sets, for the first time, a numerical aspirational target to cut road deaths" (ETSC 2001). ETSC strongly supported "the Commission's intention to set an ambitious goal, but notes that the targeted level of safety performance is more challenging than has ever been achieved by even the best performing Member States or proposed by the European Parliament and safety organisations" (ETSC 2001).

## The Third Action Program in 2003 and ETSC's Response

The EU's Third Road Safety Action Programme was adopted in 2003 and was a much more comprehensive document than previous ones, encompassing a total of 62 measures. It reiterated the target set out in the Transport White Paper, namely, to cut EU road deaths by 50% between 2000 and 2010. The program explained that targets can mobilize action and that "It is broadly accepted that targeted road safety programs are more beneficial in terms of effectiveness of action, the rational use of public resources and reductions in the number of people killed and injured than non-targeted programmes" (European Commission 2003). The European Commission also stressed that the target needed to be monitored closely and reviewed especially with the upcoming enlargement of the EU. Performance indicators could also be used in a next stage, although their adoption finally came in 2019 for use in the new 2021–2030 program.

With the adoption of the Third Action Programme in 2003, one of the key framework elements of Vision Zero, "creating mechanisms for change," was put in place including a strategy, a target and some elements of European road safety governance as well as lots of measures.

The European Commission's 2003 program mentioned the Swedish Vision Zero in passing when elaborating possible action in the area of public procurement: "In 1997 Sweden adopted a road safety program to combine the efforts of the State, the regions, the towns, the private sector and individuals to aim to achieve zero death and serious injuries on the road" (European Commission 2003). But the adoption of Vision Zero as a guiding road safety philosophy for Europe was still a way off.

The 2003 EU Action Program was entitled "Halving the Number of Road Accident Victims in the European Union by 2010: A Shared Responsibility," thus clearly including the second key element of Vision Zero on sharing responsibility amongst road users and the authorities (European Commission 2003). The strategy also called for "a shift in thinking among both those with responsibility for the traffic system and users about how people use the roads and how they can be used safely" (European Commission 2003).

The third element of Vision Zero – "philosophy of safety: a system absorbs errors" – was also included: "Since human beings frequently and inevitably make mistakes, the system of infrastructure, vehicles and drivers should be gradually adapted to protect users more effectively against their own shortcomings" (European Commission 2003), citing influence from "the approach in other modes of transport and safety at work" (European Commission 2003).

ETSC's response papers to the new European Commission program included a subtitle of "A Strategy without a Bite?," repeating the concern about the ambitious target (ETSC 2003). ETSC called for the need for more action at EU level and also for the new EU member states set to join the EU in order to reach the new target (ETSC 2003). ETSC also raised a concern that there was no vision included in the action programme. ETSC said that a targeted road safety programme should be accompanied by a vision, such as the Vision Zero in Sweden (ETSC 2003). Specifically, it said that motivating change needs a common vision. "To achieve the necessary shift in the mind-set of decision-makers and stakeholders, the vision needs to be further-reaching and medium to long-term, looking beyond what is immediately achievable" (ETSC 2003).

## 2004: The European Parliament Proposes to Endorse Vision Zero for the First Time

The European Parliament adopted its resolution on road safety in 2004 as a response to the new EC Action Program, welcoming the new EU target to reduce road deaths (European Parliament 2004). The report also called "on the Commission to develop a long-term road safety concept, going beyond 2010 and describing the required steps leading to the avoidance of all fatalities and serious injuries caused by road accidents ('zero vision')" (European Parliament 2004). In the explanatory statement, it added that "the very long-term objective is the Nordic Vision Zero" (European Parliament 2004).

## The Verona Process: Commitment of the Transport Council on Road Safety 2003–2006

It was during this time also that transport ministers met more regularly to discuss road safety. The first occasion was on the initiative of the Italian EU Presidency and hosted by the mayor of Verona, who was very keen to see more action on road safety. EU transport ministers confirmed the urgent need for action on road safety and proposed a number of measures. In the first ministerial declaration from 2003, ministers stated that "the huge amount of human victims on the roads is too high a price and that, the situation being such, the eradication of this scourge is a top priority on their political agenda" (European Council 2003).

Within this context, ETSC was aiming to capitalize on the political leadership shown by the Italian Presidency and others by suggesting the launch of the so-called

Verona Process (ETSC 2003a). ETSC's recommendation was to use the EU policymaking method of open coordination, which would lead to regular ministerial meetings on road safety.

This process had already been successfully applied in other sectors, for instance, in the "Lisbon Process" on economic development. ETSC argued that "this new process would serve primarily to create the political leadership needed for action on road safety through an annual review based on performance indicators" (ETSC 2003a). This didn't really catch on, but successive EU Presidency holders have continued to demonstrate their commitment to road safety to the present day, thus fulfilling some of the other elements of Vision Zero such as taking shared responsibility for road safety and supporting a 'mechanism for change.'

At the second meeting in December 2004, again hosted by Verona, European transport ministers formally adopted the conclusions from their second Verona meeting on road safety. In these conclusions, ministers again outlined priorities for enhancing road safety by improving road design, compliance with rules and vehicle safety (European Council 2004). As regards the funding of road safety work, ministers proposed the creation of a European road safety fund, drawing on a percentage of vehicle taxes, motorway tolls, insurance premiums or traffic fines.

Yet, "the Commission distanced itself from the Ministers' conclusions, stating it would act only in accordance with the right of initiative given to it by the treaties" according to ETSC's "Safety Monitor" (ETSC 2004b). In a declaration attached to the document, the Commission warned against "anticipatory effects" for measures which are difficult to implement, such as the "establishment of specific funds to finance measures to improve road safety" (as cited in ETSC 2004b). At this moment in the EU's road safety history, the European Commission was not in step with the level of political ambition demonstrated by the Council.

A third Verona meeting was held in November 2005. Transport ministers adopted conclusions in which they committed to promoting road safety policies in their respective countries, based notably on improving driver training, provisional driving licenses for young drivers and additional training for repeat offenders (as cited in ETSC 2005b). The conclusions also placed an emphasis on tougher sanctions. This was just ahead of an informal council on road safety hosted by the Austrian government under their EU Presidency in Bregenz in March 2006.

The focus of the meeting in Bregenz was on E-Safety with a practical demonstration on a track allowing ministers to try out vehicles fitted with new safety technologies. During the meeting, the European Commission presented the mid-term review of the Third Road Safety Action Program and as ETSC reported "took the Council's pulse" before preparing to present new legislation on topics such as cross-border enforcement and infrastructure in 2006 (ETSC 2005a). After this, the more regular council meetings dedicated to road safety had a hiatus. But elements of Vision Zero here were also starting to take root, shown by the political ambition of EU transport ministers to hold regular meetings with road safety as a focus.

## ETSC PIN Program

It was within this context that ETSC launched its Road Safety Performance Index program (PIN). Since 2006, the Road Safety Performance Index program (PIN) has presented an annual award to the European country making the best progress in reducing road deaths. The annual PIN ranking of progress has inspired many poor performing countries to up their game. The PIN is a policy tool to help EU Member States improve road safety. By comparing Member States' performance, it serves to identify and promote best practice in Europe and bring about the kind of political leadership that is needed to create a road transport system that maximizes safety.

The PIN program covers all relevant areas of road safety including road user behavior, infrastructure and vehicles, as well as road safety policymaking more generally. National research organizations and independent researchers from 32 countries participate in the programme and ensure that any assessment carried out within the program is based on scientific evidence and is effectively communicated to European road safety policymakers.

Since the beginning of the program, cross-national comparisons have addressed a wide range of road safety themes and indicators. The PIN program includes a number of Vision Zero's key elements. The ethics of not having a trade-off of safety for mobility, supporting the creation of a system which absorbs errors and sharing responsibility between road users, authorities and industry are integrated into their annual reports and data-led reports, as is element four on "creating mechanisms for change" tracking country's developments and adoptions of targets, strategy and governance.

One of the later reports looking at this aspect was the "Road Safety Management" flash report published in 2012 (ETSC 2012). It presented a snapshot of the Road Safety Management frameworks in terms of key elements inspired by best practice and innovative experience in Member States. The PIN report stressed that "systematic and strategic thinking, complemented by actions on the lines recommended are vital for the sustained medium- and longer-term reductions in death and injury on the roads" (ETSC 2012). The overview was based on questions linked to the ETSC publication from 2006: "A methodological approach to national road safety policies" (ETSC 2006a).

## 2006: Mid-term Review of the Transport White Paper and the Fourth Road Safety Action Program

The next significant milestones were the mid-term reviews of the Transport White Paper and the Third Road Safety Action Program in 2006. ETSC repeated its previous call for the adoption of a road safety vision: "A prerequisite for effective action to reduce death and injury in traffic collisions radically is a strongly felt and lasting motivation for change which is sufficient to root out and overcome deep-seated tolerance of disproportionate numbers of people being killed or injured on the roads" (ETSC 2006b). Adding that, "one way of generating and communicating such a motivation for change is by promoting an inspiring vision of safer road use" (ETSC 2006b). The mid-term review of the Transport White Paper just reaffirmed the new target and created an annual road safety day (European Commission 2006a).

The European Commission's mid-term review of the Road Safety Action Programme listed the actions taken and traced the reduction trends. Some elements of the "Vision Zero" approach such as that of the 'system absorbing the errors' found their ways into the thinking. For example, under the vehicle section, "all road users are liable to make mistakes. Given the potential seriousness of these mistakes, we must limit their consequences (passive safety) or prevent them from occurring in the first place (active safety)" (European Commission 2006b), concluding that "faster progress is being made than in the past, but it is patchy and there is still a lot of room for further improvement" (European Commission 2006b). Emphasis was put on the newly adopted concept of "shared responsibility." another important element of Vision Zero.

ETSC's 2000 response urged for renewed action in delivering stalled legislative priorities and demanding a tighter interpretation of "sharing responsibility" (ETSC 2006b). ETSC also stressed that "More than sharing responsibility, Member States, the European Commission and the automotive industry should 'take' their responsibilities. The development of guidelines on implementing best practice by Member States should not replace the need for an EU directive on any given matter, but should instead represent a step toward concise legislation at EU level" (ETSC 2006b).

In 2006, the European Parliament repeated their calls for the adoption of Vision Zero that had first been mentioned in 2004. In their contribution to the mid-term review of the Road Safety Action Program in 2007, MEPs called for "the Commission to develop a long-term road safety strategy beyond 2010 and setting out the steps required for the avoidance of all fatalities and serious injuries caused by road accidents ('Vision Zero')" (European Parliament 2007), thus continuing to mention Vision Zero by name as well as including many of the key elements such as the "mechanism for change" calling for a strategy with targets.

## Ahead of the Adoption of Vision Zero in 2011

Following the mid-term reviews of both the Transport White Paper of 2001 and the Road Safety Action Program of 2003, ETSC then set about preparing the main input to the next Road Safety Action Program (ETSC 2008). ETSC's 2008 blueprint document recalled that every far-reaching road safety program needs a vision. Taking inspiration from Sweden but not Vision Zero, ETSC proposed that "every citizen has a fundamental right to, and responsibility for, road traffic safety. This right and responsibility serves to protect citizens from the loss of life and health caused by road traffic." This citizen's right was adopted in the Tylősand Declaration at the annual Swedish conference on traffic safety in 2007 (Tylősand Declaration 2007) and then adapted by ETSC, strengthening the responsibility component.

Ahead of the adoption of Vision Zero in the EU Transport White Paper, the European Parliament report provided input but did not repeat its call for a Vision Zero from 2006. However, MEPs did stress that road safety and the new target for 2020 should be an important part. Calling for "a 40 % reduction in the number of deaths of and serious injuries to active and passive road transport users, with this target being laid down in both the forthcoming White Paper on Transport and the new Road Safety Action Programme" (European Parliament 2010).

## Adoption of the Third Road Safety Action Program in 2010

ETSC was very critical of the adoption of the Third Road Safety Action Program which came in 2010, just ahead of the landmark Transport White Paper which finally adopted Vision Zero (ETSC 2010), mainly because of the dilution of the European Commission's previously expressed ambition and what it viewed as a downgrading of road safety as a priority for EU transport policy.

Moreover, ETSC did not yet know what was just around the corner, i.e., the EU's adoption of Vision Zero. ETSC wrote that the "'Towards a European Road Safety Area: policy orientations on road safety 2011-2020' include some elements of an Action Programme, yet its scope, structure and name are very different from the three previous European Road Safety Action Programm" (ETSC 2010), although a new target to halve road deaths was set for 2020.

ETSC said that the decision of the European Commission to adopt "policy orientations" with a weak set of objectives and actions instead of a new far-reaching European Road Safety Action Program called seriously into question the chances of reaching the target (ETSC 2010). Moreover, the road safety community had hoped for a new EU 10-year action program providing a vision, priorities and a detailed road map against which performance could be measured and delivery made accountable. ETSC concluded that "the adopted Communication falls short of these expectations" (ETSC 2010). In terms of a vision, there was no clearly defined vision in the document, only "principles" (ETSC 2010).

The 2010 EC Action Plan stated that "Road Safety policy has to put citizens at the heart of its action: it has to encourage them to take primary responsibility for their safety and the safety of others. The Road Safety Policy aims at raising the level of road safety, ensuring safe and clean mobility for citizens everywhere in Europe" (European Commission 2010).

These are principles, which ETSC also viewed with a critical eye. ETSC recognized "the important responsibilities of road users but believes that it is just as important for the traffic system to be adapted to their needs, errors and vulnerability. Putting the citizen at the heart of the action should not mean moving responsibilities from authorities to citizens, but emphasising the human role as a measure of EU policy actions." Here, the European Commission's new road safety program did not encompass one of the key elements of Vision Zero regarding sharing responsibility nor building a system which can absorb errors.

ETSC was also skeptical of the bold statement in the Road Safety Policy Orientations communication and what it said regarding new legislation that "with over a dozen legislative instruments on road safety, the EU acquis are essentially in place" (ETSC 2010). ETSC said that this revealed a disturbing complacency about the legislative foundation for action for the next decade (ETSC 2010). The European Commission stated that it "intends to give priority to monitoring the full and correct implementation of the EU road safety acquis by Member States" (European Commission 2010). ETSC argued that there was still a great deal that should still be done in the next decade in the field of EU legislation to improve road safety (ETSC 2010).

Another area of disappointment was that, although the European Commission included a new emphasis on serious injuries, it did not yet set a target (ETSC 2010). ETSC called for the swift adoption of a detailed road map, saying that its absence may result in the situation in which slower Member States hold back those already prepared to work with a standardized definition (ETSC 2010). ETSC was stressing that this process was bound to take time and that an interim target should be set in terms of countries' existing definitions of serious injury (ETSC 2010).

Although the new program had some of the elements of Vision Zero, it was weak under the part on "creating mechanisms for change: targets, strategy, governance and adopting measures." A strategy was there in parts including a target to reduce deaths, but not yet serious injuries, and the measures were much reduced, especially in light of the challenges to reach the new road death reduction target by 2020.

There was more EU action to come in 2011 with the adoption of the new Transport White Paper. In 2010, ETSC had said that the Commission "should consider the need to include a strong section in the white paper on road safety, reiterating there the new 2020 target to reduce road deaths by 50%" (ETSC 2010).

## The Groundbreaking Adoption of Vision Zero in the 2011 Transport White Paper

With the background of the 2010 Road Safety Policy Orientations and ETSC's critical input, the adoption of "Vision Zero" in the Transport White Paper the following year came as a surprise to the road safety community (European Commission 2011).

One of the ten goals for achieving a competitive and resource-efficient transport system was set as "By 2050, move close to zero fatalities in road transport. In line with this goal, the EU aims at halving road casualties by 2020" (European Commission 2011).

Including a "Vision Zero" for road safety was recognized as a new and potentially groundbreaking visionary goal for 2050 by ETSC, complementing the "Road Safety Policy Orientations 2011–2020" target of halving road deaths by 2020 (ETSC 2011a).

ETSC congratulated the European Commission on this new long-term vision and welcomed the White Paper's renewed commitment for an EU target to reduce road deaths by 50% by 2020 (ETSC 2011a). The transport safety section of the Transport White Paper was entitled "Acting on Transport Safety: Saving Thousands of Lives" and subtitled "Towards a 'zero-vision' on road safety" and contained a summary of the actions from the previously adopted Road Safety Policy Orientations (European Commission 2011).

However, what was missing at the time was a root and branch reorganization of the EU's road safety management structure and governance in line with all of the elements of "Vision Zero." The White Paper did not elaborate the idea of sharing responsibility between the different actors nor the principle of building a system which absorbs errors. The "chapeau" heading of "Vision Zero" included some intended measures but was not supported by the necessary actions.

## Vision Zero Supported by the European Parliament

Just after the adoption of Vision Zero in the 2011 Transport White Paper, the European Parliament also adopted a new report in 2011, entitled European Road Safety 2011–2020 (European Parliament 2011). MEPs shared some of ETSC's criticisms of the EC's 2011 "policy orientations" stating that "The EU must make a start on the work of turning this vision into reality and developing a strategy which looks beyond the 10-year time frame" (European Parliament 2011).

In an opening section in the report on "ethical aspects," MEPs warned that "a complementary, long-term strategy is needed which goes beyond the period covered by the communication under consideration here and has the objective of preventing all road deaths ('Vision Zero')" (European Parliament 2011). This view had been supported by ETSC in a briefing for MEPs (ETSC 2011b). A whole section of the report was dedicated to "Vision Zero" explaining that 15,000 deaths in 2020, though an improvement, were still not acceptable:

> Your rapporteur wholeheartedly supports the objective of halving the number of road deaths by 2020. This means, however, that in 2020 some 15,000 people would still lose their lives in road accidents. The price EU citizens pay for their mobility would thus still be shockingly high. If even one person is killed or injured in a road accident it is one too many. Although absolute safety is an impossibility, the objective of only halving the number of road deaths – however ambitious it may be given the period – is ethically questionable. The Commission should therefore finally acknowledge Parliament's call and set as the long-term aim the prevention of all road deaths ("Vision Zero"), as a number of Member States have already done (European Parliament 2011).

The appeal of the EP to consider the ethical implications of setting short-term targets and appealing for longer-term planning embodies one of the elements of Vision Zero.

## Corporate Sustainability Reporting

The EU is an influential leader in setting global sustainability reporting standards. A little later in 2014, the EU also adopted a directive requiring large companies to disclose certain information on the way they operate and manage social and environmental challenges (European Union 2014). The thinking was that this can help investors, consumers, policymakers and other stakeholders to evaluate the non-financial performance of large companies and encourages these companies to develop a responsible approach to business. The so-called Non-financial Reporting Directive 2014/95 (NFRD) lays down the rules on disclosure of non-financial and diversity information and amends the accounting Directive 2013/34/EU. Although there is no specific reference to road safety, health and safety at work are included. This links into the idea of Vision Zero that responsibility is shared beyond the public sector in delivering on social and environmental goals, which could also include road safety.

According to the legislation, companies with more than 500 employees are required to include non-financial statements in their annual reports from 2018 onward. Under Directive 2014/95/EU, large companies have to publish reports on the policies they implement in relation to environmental protection, social responsibility and treatment of employees (including health and safety at work), respect for human rights, anti-corruption and bribery as well as diversity on company boards. The EC adopted guidelines to elaborate reporting under the directive in 2017 (European Commission 2017), further updated in 2019 (European Commission 2019a). The directive is also due for revision under the European Green Deal with a consultation for the revision underway in February 2020 to strengthen sustainable investment even further (European Commission 2020e).

The Stockholm Declaration of 2020 on road safety includes a recommendation which calls upon "businesses and industries of all sizes and sectors to contribute to the attainment of the road -safety-related SDGs by applying Safe System principles to their entire value chain including internal practices throughout their procurement, production and distribution process, and to include reporting of safety performance in their sustainability reports" (Stockholm Declaration on Road Safety 2020). This is explained further in the report of the Academic Expert Group for the Stockholm Declaration (Stockholm Declaration on Road Safety Academic Expert Group 2020). Global supply chains associated with multinational corporations account for over 80% of global trade and employ one in five workers (Thorlaksen et al. 2018).

## Mid-term Review of the Transport White Paper and Road Safety Policy Orientations

At the halfway point of the target period for 2020, in early 2015, the European Commission undertook a review of the Road Safety Policy Orientations and the Transport White Paper, with the European Parliament undertaking an Own Initiative Report on the White Paper. The European Commission opened a public consultation on progress on the Road Safety Policy Orientations at the end of 2014 and on the Transport White Paper shortly afterward. In its contribution to both of these reviews, ETSC called upon EU policymakers to redouble European efforts in the field of road safety and to strengthen and expand the scope of action needed to reach the 2020 target (ETSC 2015a).

The European Parliament in its contribution to the mid-term review of the Transport White Paper had a strong section on road safety under “Placing people at the heart of transport policy.” The Resolution stressed that “although significant improvements have been achieved in road safety over the past years, differences between Members States still persist and further measures are needed to attain the long-term Vision Zero objective” (European Parliament 2015).

MEPs called for a raft of different actions, very much in line with ETSC’s recommendations at the time, including for the European Commission to come forward with a revision of vehicle safety legislation (the GSR 2009/661), to improve HGV safety and to mandate the “greater application in new passenger cars and commercial vehicles of driver assistance safety systems such as overridable intelligent speed adaptation (ISA)” (European Parliament 2015). Already then, they were calling for a revision of Directive 2008/96/EC on road infrastructure safety management, calling for an extension of its four main measures to other parts of the road network, including all parts of motorways and rural and urban roads. They were also calling for the European Commission to review driving license legislation to, for example, introduce a second phase to obtain the full license and a harmonized EU blood alcohol concentration limit of 0.0 for professional drivers and for new drivers in the first 2 years. These latter measures have still not happened to date.

## The Adoption of an EU Serious Injury Target and Its Importance for Vision Zero in Europe

In its 2015 resolution, the European Parliament called for “the swift adoption of a 2020 target for a 40% reduction in the number of people seriously injured, accompanied by a fully-fledged EU strategy” (European Parliament 2015). Furthermore, MEPs called on “the Member States to provide without delay all relevant statistical data so as to enable the Commission to set that target and strategy” (European Parliament 2015). But the EU had to wait until 2019 for the final adoption of such a target. This is significant for Vision Zero in Europe as it illustrates the difficulties in adopting targets beyond reducing deaths, an important part of the Vision Zero philosophy.

The mid-term review of both the Road Safety Policy Orientations and the Transport White Paper came just after the start of the mandate of the new European Commissioner for Transport Violeta Bulc. The road safety community had high hopes for new action, and the new commissioner made a promising start. ETSC was especially looking forward to the adoption of an EU target for reducing serious injuries, which had been long promised. Although a common EU definition of seriously injured casualties was adopted in 2013 (European Commission 2013), the EU had previously missed the opportunity to adopt a target and measures to achieve it.

ETSC had long argued for the need for a separate pan-European target to reduce serious road injuries, to complement the targets that have been in place since 2001 to reduce deaths. Since 2010, the European Commission committed to introducing such a target. In 2013, the crucial common definition of the types of injuries to be recorded and tracked was approved (European Commission 2013). A target was finally expected to be set in the first half of 2015, having been promised "shortly" in a Commission press release in 24 March 2015. But the European Commission backtracked, and the target was placed in limbo. ETSC convened an expert meeting in March 2015 to discuss a priority list of measures for EU action to reduce serious injury (ETSC 2016a).

A step was taken when the European Commission published, for the first time, a figure in April 2015 for the estimated number of people seriously injured on Europe's roads: 135,000 in 2014 (European Commission 2015).

ETSC then launched an official campaign entitled "Let's Go for a European Serious Injury Target to Reduce Road Injuries" calling on the Commission to publish a target by the end of 2015 (ETSC 2015b).

More than 70 experts and representatives of road safety organizations and victims groups from across Europe together with 12 members of the European Parliament wrote to the European Commission President Jean-Claude Juncker urging him to reverse the decision to drop the target. Public health groups and medical experts from across Europe joined the call along with transport ministers from across the EU. Also in 2015, ETSC worked with the Luxembourg Presidency who arranged a debate on the Transport White Paper at the October Council and a lunch debate on road safety at the December Council. Both debates included the serious injury topic. In February 2016, ETSC met with both President Juncker and Transport Commissioner Bulc to hand over the banner from the campaign and press the case for setting a target (ETSC 2016b).

A group of MEPs launched the initiative to sign a "written declaration" on the importance of the serious injury target. The declaration was signed by 275 MEPs.

## The Valletta Declaration and the Adoption of an EU Serious Injury Target

One of the key milestones in the run-up to the adoption of the serious injury target was the adoption of the Valletta Declaration on road safety (EU Council Valetta Declaration 2017). Malta held the EU Presidency in the first half of 2017 and wanted to contribute to improving road safety. The Maltese Presidency organized a high-level conference and an Informal Ministerial Transport Council on the 28th and 29th of March 2017 where the Valletta Declaration on road safety was officially adopted.

ETSC participated in a preparatory meeting organized by the European Commission and sent initial written input to both the European Commission and the Maltese Presidency on the draft declaration. Ahead of the meeting in January, ETSC contacted all EU 28 Member States to present their priorities for inclusion. The main request from ETSC was for EU Member States to endorse an EU target for serious injuries.

The Valletta Declaration was adopted on 28 March, including a call for the adoption of an EU serious injury target. In June 2017, European Union transport ministers formally agreed to set a target of halving the number of serious injuries on roads in the EU by 2030 from their 2020 level (EU Council 2017). In their council conclusions, ministers formally endorsed the Valletta Declaration on improving road safety, issued at the informal meeting organized by the Maltese Presidency on 29 March 2017. Ministers called on the European Commission to come forward with a new road safety strategy for the decade 2020–2030 including targets for reducing deaths and serious injuries (ETSC 2017a). The road safety community still had to wait until 2018 until the targets were finally adopted within the new strategy.

## EU Road Safety Action Policy Framework: Next Steps Towards Vision Zero

In June 2019, the European Commission published the EU Road Safety Policy Framework 2021–2030: Next Steps Towards "Vision Zero" (European Commission 2019). The publication was a follow-up to a shorter action plan published in May 2018 (European Commission 2018a), as part of the Mobility Package III, which included two new road safety regulations on vehicle and infrastructure safety standards. In its launch press release, the European Commission stated that "These two measures [on vehicle and infrastructure safety] could save up to 10,500 lives and avoid close to 60,000 serious injuries over 2020-2030, thereby contributing to the EU's long-term goal of moving close to zero fatalities and serious injuries by 2050 ('Vision Zero')" (European Commission 2018b). A strong link to Vision Zero was repeated by Commissioner Bulc: "Today the Commission has completed its agenda for safe, clean and connected mobility. New decisive steps towards #"VisionZero: 0 fatalities on EU roads, 0 pollution, 0 paper by 2050" (European Commission 2018c). Throughout her tenure, Commissioner Bulc was a strong advocate of Vision Zero and was sure to include it in her many speeches and updates on road safety.

ETSC was broadly positive of the new strategy and welcomed that the long-term Vision Zero would guide the announced EU Road Safety Policy Framework for 2021–2030 and embody the "Safe System Approach" (ETSC 2019e) and also that it included a new target to halve road deaths between 2020 and 2030 as well as, for the first time, a target to reduce serious injuries by the same amount. Thus, it enshrined the targets adopted in the Valletta Declaration.

### Ethics

Looking at the inclusion of the Vision Zero elements of ethics, philosophy, shared responsibility and mechanism for change, in the new document, all could be interpreted as being present in some form.

In terms of ethics and vision, the introduction says "the EU has reaffirmed its ambitious long-term goal, to move close to zero deaths by 2050 ('Vision Zero')" (European Commission 2019c). They speak of "the mind-set of 'Vision Zero'" which "needs to take hold more than it has so far, both among policy makers and in society at large." The European Commission makes an oft-cited parallel with air traffic. "Road crashes are 'silent killers,' in that they often go virtually unnoticed in the public sphere, even though, taken together, they kill as many people – around 500 – as fit into a jumbo jet every week, in Europe alone" (European Commission 2019c). Then also in line with the original Vision Zero, "We do not accept deaths in the air, and we should no longer accept them on the road – the premise that no loss of life is acceptable needs to inform all decision making on road safety" (European Commission 2019c). This is supported by the adoption of the Safe System Approach: "The core elements are ensuring safe vehicles, safe infrastructure, safe road use (speed, sober driving, wearing safety belts and helmets) and better post-crash care, all long established and important factors in the Safe System approach" (European Commission 2019c).

## Shared Responsibility

A whole section of the new strategy is dedicated to "shared responsibility" which states that for "the Safe System approach to work, experience shows that all actors need to play their part in a coordinated manner" (European Commission 2019c) and also that the overarching theme of the Safe System Approach "involves multi-sectoral and multi-disciplinary action and management by objectives, including timed targets and performance tracking" (European Commission 2019c).

ETSC stresses that "Road safety policy needs to be supported by effective institutional management in order to achieve long-term effects on road safety" (ETSC 2019e). Moreover, "clear institutional roles and responsibilities should be set up with strong political leadership from the Commissioner for Transport" (ETSC 2019e). The European Commission has since worked to enhance the mandate of the High-Level Group on Road Safety, which is made up of representatives of EU member states, and will now organize "results conferences" every 2 years. The European Commission has also appointed a European Coordinator for Road Safety and expressed the intention to coordinate at senior level involving all DGs with policies relevant to road safety. ETSC however is still calling for more, for example, "the development of a more complete framework which should include clear priority measures for action and a detailed road map against which performance is measured and delivery made accountable to specific bodies. As an example of such an approach ETSC referred to the Irish Road Safety Strategy" (Ireland Road Safety Strategy 2013).

Moreover, ETSC is critical of the efforts to "share responsibility" with industry. A part of the proposed actions in the Commission's road safety action plan comes in the shape of "voluntary commitments" from stakeholders, for example, the Vision Zero pledge from ACEA (ACEA 2018). ETSC says that "although such commitments can be welcome, especially in new areas as a precursor to legislation, it is less favourable as the action may not end up being completed without the legislative obligation" (ETSC 2019e).

## Philosophy of Safety

The part of the Vision Zero and Safe System philosophy about building a system which absorbs errors is also included in the new EU strategy. For example, in the introduction:

> According to the Safe System approach, death and serious injury in road collisions are not an inevitable price to be paid for mobility. While collisions will continue to occur, death and serious injury are largely preventable. (European Commission 2019b)

The strategy goes on:

> The Safe System approach aims for a more forgiving road system. It accepts that people will make mistakes, and argues for a layered combination of measures to prevent people from dying from these mistakes by taking the physics of human vulnerability into account. (European Commission 2019b)

In terms of the different elements of the system:

> Better vehicle construction, improved road infrastructure, lower speeds for example all have the capacity to reduce the impact of crashes. Taken together, they should form layers of protection that ensure that, if one element fails, another one will compensate to prevent the worst outcome. (European Commission 2019b)

Under, for example, the section on infrastructure:

> Well-designed and properly maintained roads can reduce the probability of road traffic accidents, while "forgiving" roads (roads laid out on Safe System principles e.g. with median safety barriers to ensure that driving errors do not need to have serious consequences) can reduce the severity of accidents that do happen. (European Commission 2019b)

## Mechanisms for Change

Under the section in the strategy entitled "Safe System approach at EU level," the European Commission presents a framework including targets and key performance indicators and also examines how to change the structures to deliver and improve road safety policy at EU level.

An example of a very new "mechanism for change" is the plan to develop new key performance indicators (KPIs) for road safety, linked to outcome targets already announced by the European Commission in May 2018 (European Commission 2018a).

According to a 1993 directive, EU Member States are legally obliged to report to the European Commission on the number of road collisions that result in injury or death. These new KPIs should give a more detailed sense of how Member States are performing in terms of reducing some of the most important risks. However, the reporting on KPIs will be voluntary, thus putting in place some new parts of the Vision Zero structure: "creating a mechanism for change."

ETSC in its response to the new strategy stated that "strong measures and a wider coverage of existing and emerging road safety issues will be essential to addressing the recent stagnation in progress on reducing road deaths in the EU" (ETSC 2019e).

ETSC said that although the Commission's analysis of the current state of road safety in Europe was correct, the planned policy approach would need renewed effort if it will result in the needed rapid and far-reaching improvement (ETSC 2019e).

In particular, rapidly evolving technologies such as micromobility and automated driving need substantial regulatory efforts now to avoid creating new and unforeseen risks. Long-term research into these, and other areas, is welcome – but robust legislation following the precautionary principle and the Safe System Approach will be needed sooner rather than later (ETSC 2019e).

The new EU strategy was adopted in the midst of a road safety crisis in Europe, a drastic slowdown in the positive trend of reducing road deaths and the realization that the 2020 EU road death reduction target would not be reached.

Since 2010, the average annual progress in reducing the number of road deaths in the EU is 2.8%, a 21% reduction between 2010 and 2018. Most of that progress was made in 2011, 2012 and 2013. A 6.7% year-to-year reduction was needed over the 2010–2020 period to reach the 2020 target (to halve road deaths in a decade) through consistent annual progress. Since 2013, the EU as a whole has been struggling to reach a breakthrough. The number of road deaths declined by only 4% in the 5 years since 2013. For the EU to reach the 2020 target, road deaths now need to be reduced by around 20.6% annually in 2019 and 2020 – an unprecedented and highly unlikely possibility.

## Renewal of Vision Zero plus the Safe System Approach: Is This Enough to Deliver Vision Zero in Europe?

Since the adoption of Vision Zero in 2011, the new EU strategy for 2021–2030 has had more elements of the Vision Zero integrated than in the original 2011 road safety strategy and White Paper, especially in the areas of "ethics" and "governance," although more could still be done to strengthen, for example, the governance structure.

ETSC has repeatedly called for the setting up of an EU agency for road safety, as exist for other transport modes. Such an agency could be "responsible for the collection and analysis of data, helping speed up developments in road safety and providing a catalyst for road safety information and data collection" (ETSC 2019e). The agency could also come up with new safety standards for vehicles as well as overseeing and coordinating EU input to the UNECE process (ETSC 2019e).

In themselves, the implementation of all of the planned actions in the EU strategy will not be enough to deliver the long-term Vision Zero nor possibly the new 2030 targets. ETSC has commented on the possible causes of the recent stagnation in the EU. “The economic recovery, and consequent increase in road transport usage, partly explains the lack of progress. As do cuts to transport police numbers and infrastructure maintenance budgets by Member States as road safety fell down the political priority list in some countries” (ETSC 2019e).

Other explanations could be about the possible consequences of EU and Member State inaction and delay of adopting new life-saving policies in its PIN Annual Report (ETSC 2019d). “But the EU must also shoulder some of the responsibility for waiting almost until the end of its five-year political cycle to deliver its biggest and boldest road safety initiatives: an update to minimum vehicle safety standards and a significant increase in the scope of infrastructure safety management rules” (ETSC 2019). These eventually came in May 2018, with final political agreements reached in the last few months of 2019. ETSC recognizes that this was a massive achievement, which will save thousands of lives. But it will be several years before we see the full impact (ETSC 2019e).

The EU will have to show strong political will from the start of the new mandate, including from the newly appointed EU Transport Commissioner Ms. Vălean, if it wants to reach the new 2030 targets.

In her opening statement at her hearing in the European Parliament, Ms. Vălean said, “25 000 [deaths] per year is simply unacceptable. We should share the objective of halving the number of road deaths and serious injuries by 2030 compared to 2020.” Later at the same hearing, she affirmed that “for road safety we are committed to zero vision, zero deaths in 2050. We put a strategy in place and I plan to promote it strongly. With strategy comes actions” (ETSC 2019f).

This is mirrored at a higher level in the “mission letter” to the new transport commissioner, from the European Commission President Mrs. von der Leyen: “Cutting across all of your priorities is the need for the highest safety standards. This is becoming all the more important as traffic increases and security threats become ever more complex” (European Commission 2019d). Together, this implies the intended willingness to act of the new commissioner with competence for road safety and the president of the European Commission.

The EU will need to fulfil, as a minimum, all of the planned actions in the EU realm of implementation.

ETSC in its response says that the planned actions are not sufficient and in its response document puts forward more possible actions under the different priority actions saying that there is “room for improvement and increased ambition” (ETSC 2019e). Yet, it needs also to go above and beyond and work to encourage EU Member States to place road safety high on the political agenda. ETSC wrote in its response to the new EU strategy that “as well as putting forward legislation, in the next decade the European Commission must continue to fulfil its crucial role in supporting and motivating EU Member States to act” (ETSC 2019e). Moreover, it must now also rise to the challenge of dealing with the Covid-19 pandemic and probable economic downturn.

## Examples of Vision Zero in Action at EU Level

New legislation on infrastructure and vehicle safety was finally adopted in 2019; both are due to have a substantial impact on reducing deaths and serious injuries and the implementation of Vision Zero. This next section will show how these examples of legislation have been adopted since the inclusion of Vision Zero in the Transport White Paper of the EU in 2011 and the EU road safety strategy.

## Adoption of the General Safety Regulation on Minimum Vehicle Safety Standards in the EU

Already in 2010, the European Commission indicated in its communication on "Policy Orientations on Road Safety 2011–2020" that it would make proposals to encourage progress on the active and passive safety of vehicles (European Commission 2010). ETSC much welcomed the priorities set by the European Commission at the time to focus on technologies tackling speeding and drink driving. In particular, the inclusion of "in-vehicle systems providing real-time information on prevailing speed limit" was recognized as a potential first step to introducing Intelligent Speed Assistance (ETSC 2010). This was a long-standing important priority of ETSC; ISA was recognized as an important life-saving measure and part of the Vision Zero philosophy of safety, creating a system which absorbs errors (ETSC 2010), in this case speeding, often a simple error of overseeing a speed limit sign. Other types of in-vehicle safety technologies such as Advanced Emergency Braking Systems and Lane Keeping Assist could also be classed in the same way. These were also finally included in the final adopted legislation. But it would take another 8 years until a legislative proposal was made.

In late 2016, the European Commission presented its report "Saving Lives: Boosting Car Safety in the EU," which listed 19 priority measures for improving vehicle safety. Its preface stated that "In order to reach the EU strategic target of halving the number of road deaths from approximately 31,000 in 2010 to 15,000 in 2020, as stated in the Policy Orientations on Road Safety 2011–2020, additional efforts are needed as it is entirely likely that the target is not going to be reached" (European Commission 2016). ETSC was very supportive of the chosen measures and called for the swift adoption of the regulation.

The report was however not accompanied by a legislative proposal that would take even longer. This long delay was heavily criticized by ETSC who, together with thirteen other stakeholders, formed a strong coalition to make the case for bringing it forward (ETSC 2017b). Member States were also demanding action. The Valletta Declaration on Road Safety of 2017 by all EU transport ministers included a call to accelerate work on new vehicle safety standards (Valletta Declaration 2017). This followed a letter sent in February by eight ministers of transport, asking for better car and truck safety and for new vehicle safety measures to be published before the end of 2017.

Still, the proposal did not come. In the meantime, the European Parliament increased the political pressure. It adopted an own-initiative report responding to the Commission's report, in which it primarily set out its vision for the improvement of vehicle safety in the context of the revision of the GSR (European Parliament 2017). It repeated the same appeal for increased action to reach the 2020 target but also added a call for a Vision Zero goal. "Every year on Europe's roads around 25 500 people die and some 135 000 are seriously injured, so that more – and more effective – measures need to be taken, in consultation with Member States, if the vision zero goal of 'no fatalities' is to be achieved" (European Parliament 2017).

After a long wait and pressure from all sides, the European Commission finally presented its proposal revising the General Safety Regulation on 17 May 2018 as part of the Mobility Package III (European Commission 2018d). The proposal included a set of new vehicle safety measures, including mandatory installation of new driver assistance technologies, as well as revised minimum crash testing standards and measures to protect pedestrians and cyclists, to be introduced from 2022. Although repeating the need to improve road safety in Europe, the proposal did not make a specific reference to its contribution to Vision Zero nor any of the four key elements. Although there was no specific reference, as this legislation is about new vehicle safety requirements to be delivered to European consumers by industry, it does fit under "shared responsibility." Thus, industry will have to build safer vehicles, which contribute to the longer-term fulfilment of Vision Zero. As mentioned previously, industry itself has taken on the Vision Zero language with, for example, the Vision Zero pledge from ACEA (2018).

The GSR text missing a reference to the EU's Vision Zero as set out in its road safety strategy is in contrast to the Road Infrastructure Safety Management Directive proposal presented below where there was a strong reference in the introduction as well as other supporting elements such as "forgiving roads."

The GSR was drafted by DG GROW, whereas the Road Infrastructure Safety Management Directive was drafted by DG MOVE, who are also the primary authors of the EU's road safety strategy which fully adopts the Vision Zero philosophy.

Stakeholders including the consultants TRL who were charged by the EC with preparing the proposal were encouraging an approach which would embrace Vision Zero also within the important area of the EU's vehicle safety legislation. DG GROW did stand by the principles of Vision Zero, by defending an ambitious list of mandatory safety technologies against strong pressure from industry who tried to water it down prior to publication and during the negotiations. The new GSR mandates vehicle safety improvements, which will benefit the safety of those outside vehicles, such as pedestrians and cyclists. For example, better direct vision standards will help truck drivers see more cyclists and pedestrians around their cabs.

ETSC supported all of the proposed measures, in particular those with the most potential to reduce death and injury such as overridable Intelligent Speed Assistance (ISA) and Automated Emergency Braking (AEB). Both of these technologies were already available on the market, but regulation was needed to make sure the benefits are extended to all new vehicles as standard. To garner political support for the new standards, ETSC ran a campaign during 2018 and 2019 called "Last Night the EU Saved My Life" (ETSC 2018a).

The Council adopted its informal position on 29 November 2018 (European Council 2018), which was warmly welcomed by ETSC as a "massive step for road safety" (ETSC 2018b). The European Parliament adopted its informal position on the proposal on 21 February 2019. This included two proposed amendments to include Vision Zero.

Firstly in a preamble, "The Union shall do its utmost to reduce these figures drastically aiming at the Vision Zero goal of 'no fatalities' and also proposing, under the review clause recommendations, in order to support the developments towards Vision Zero driving" (European Parliament 2019), though, regrettably, these proposed references to Vision Zero were not included in the final agreed text.

ETSC welcomed the new safety proposals and also the fact that MEPs argued that the new rules should be fast-tracked and the request that eCall should also be fitted to lorries and buses in the future (ETSC 2019).

The institutions then conducted a series of informal negotiations and reached an agreement on the file on 29 March 2019 (European Parliament 2019). ETSC called the new rules "a big leap forward for road safety" and praised the leadership of EU decision-makers in concluding the negotiations (ETSC 2019b). Following the formal adoption by the co-legislators, the revised General Safety Regulation was officially published in mid-December 2019 (European Council 2019b).

The new GSR requires, as of July 2022, that all new vehicle types have to be fitted with Intelligent Speed Assistance (ISA) and all new vehicles as of July 2024. Besides a handful of high-level requirements, the new GSR however does not specify exactly how ISA is supposed to function and perform. These technical requirements are instead to be set out in a delegated act prepared by the European Commission.

The technical requirements for many of the safety measures and systems required by the GSR will be set out in UN Regulations developed by the United Nation Economic Committee for Europe's World Forum for Harmonization of Vehicle Regulations (UNECE's WP.29).

## Adoption of the Infrastructure Safety Directive

The EC published a proposal to revise the Road Infrastructure Safety Management Directive in 2018 (European Commission 2018e). Included within it is a clear reference to Vision Zero and the importance of implementing the Safe System Approach for infrastructure. As one of the first pieces of legislation proposed by the EC in the area of road safety, alongside the GSR, since the adoption of Vision Zero, this inclusion was significant:

> It is the strategic objective of the Union to halve the number of road deaths by 2020 compared to 2010 and to move close to zero fatalities by 2050 ("Vision Zero"). However, progress towards achieving these objectives has stalled in recent years. (European Commission 2018e)

The proposal also emphasized the importance of infrastructure safety design in preventing road traffic collisions, in line with the "Safe System Approach" and also embracing the main elements of the Vision Zero.

> According to the Safe System approach, death and serious injury in road accidents is largely preventable. It should be a shared responsibility at all levels to ensure that road crashes do not lead to serious or fatal injuries. In particular, well-designed and properly maintained roads should reduce the probability of road traffic accidents, whilst "forgiving" roads (roads laid out in an intelligent way to ensure that driving errors do not immediately have serious consequences) should reduce the severity of accidents. (European Commission 2018e)

In its position paper, ETSC called upon EU Member States to work toward similarly high levels of safety on all Trans-European Transport Network (TEN-T) roads, motorways and main rural and urban road networks (ETSC 2018c).

ETSC recognized that the measures in the original infrastructure safety and tunnel safety directives helped to reduce deaths in the early part of the 2010 decade. A study commissioned by the European Commission found that the impact has been positive for road safety in a number of key areas (TML 2014).

According to the European Commission, the proposed updated measures would save over 3,200 lives and avoid more than 20,700 serious injuries over the decade 2020–2030 (European Commission 2018e). ETSC's main priorities for the revision of the directive included the extension of the scope to other roads, ensuring that any road funded or co-funded from the EU budget must also be covered by EU safety rules and adapting the instruments to ensure that all road users including cyclists, pedestrians and motorcyclists are prioritized for safety measures.

The European Parliament endorsed the inclusion of Vision Zero in the outset of the proposal and also called for more ambition in various elements of the original EC proposal (European Parliament 2018).

The Council was more conservative in its position, attempting to water down the new requirements and give the Member States the possibility to designate which roads would be covered by the new directive. This was strongly criticized by ETSC as it was thought that this might reduce the safety impact should Member States choose only a small number of roads (ETSC 2018).

A compromise was struck in most areas in February 2019 with the final legislative text being published in October 2020 (ETSC 2019c). A revised version of the rules agreed extends the infrastructure safety measures from the ten TEN-T network to all motorways, all "primary roads" and all non-urban roads that receive EU funding. ETSC, and other organizations, called for all main urban and rural roads to be covered. But EU policymakers representing the European Commission, Parliament and Member States did not agree to extend the scope of the mandatory rules that far, though countries will still be able to go further if they wish.

The final text adopted included all of the original Vision Zero elements proposed by the EC. It covers shared responsibility and creating a system which absorbs errors especially with the inclusion of "forgiving roads." Regarding "providing a mechanism for change," the directive also asks governments to prepare "prioritised action plans to ensure that. . ..the findings of the network-wide road safety assessment should be followed up either by targeted road safety inspections or, if possible and cost-efficient, by direct remedial action aimed at eliminating or reducing the road safety risks" (European Council 2019).

## Conclusion

This chapter documents the roots of Vision Zero in EU road safety policymaking, from the very beginning in the mid-1980s to present day, showing that the Vision Zero approach is now integrated into the new EU road safety strategy. First examples of implementation are illustrated by references within recently adopted pieces of important road safety legislation. Yet, road safety policy needs to be supported by effective institutional management in order to achieve long-term effects on road safety and Vision Zero.

More capacity will be needed to fully expand the EU's road safety governance structures. In the area of governance, there are still some missing elements. Of help could be the creation of a cross-DG coordination group reporting both to the relevant commissioners, the road safety coordinator, and to the European Commission's High Level Group on Road Safety.

DG MOVE's lead road safety unit capacity also needs to be strengthened particularly in any further developments of its road safety strategy and targets, coordination, monitoring and evaluation functions.

The creation of a European Road Safety Agency would also aid in this regard. It could be responsible for the collection and analysis of data, helping speed up developments in road safety and providing a catalyst for road safety information and data collection.

The EU Strategic Action Plan proposes a new package of funding measures which will be further supported by the 2021–2027 EU budget, once adopted. This will also support implementation of measures on the ground to help further progress toward Vision Zero.

Specific measures need to be introduced to reduce serious injuries, in light of the new target for 2030. Specific policy measures, not just further research, are also needed on important areas such as distraction and drug-driving enforcement. There is an urgent need for a comprehensive EU regulation for vehicles with automated driving systems on-board.

Full implementation of Vision Zero is still a way off. Institutional changes are essential to make sure that commitment to Vision Zero is not just lip service to road safety. However, there are reasons to be more cautiously optimistic for the decade to come on progress, not only in reaching the 2030 road safety targets in the EU but also implementing all of Vision Zero's elements: the setting up of key performance indicators, targets and a plan for 2030 as well as the creation of a post of road safety coordinator within the European Commission. The adoption of the two latest regulations on vehicle and infrastructure safety once implemented should also bring progress. The renewed political will at the level of the European Commissioner Vălean at the start of the new political mandate should also help in working toward Vision Zero in Europe.

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# The Development of the "Vision Zero" Approach in Victoria, Australia

15

Samantha Cockfield, David Healy, Anne Harris, Allison McIntyre, and Antonietta Cavallo

## Contents



S. Cockfield (✉) · A. Harris
Transport Accident Commission (TAC), Geelong, Victoria, Australia
e-mail: samantha_cockfield@tac.vic.gov.au; anne_harris@tac.vic.gov.au

D. Healy
Road Safety Consulting, Melbourne, Victoria, Australia
e-mail: david.healy2@gmail.com

A. McIntyre
Allison McIntyre Consulting, Melbourne, Victoria, Australia
e-mail: allisonmcintyre@optusnet.com.au

A. Cavallo
Cavallo Road Safety Consulting, Melbourne, Victoria, Australia
e-mail: Antonietta_Cavallo@tac.vic.gov.au



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**Abstract**

For many decades, road safety measures in Australia focused almost exclusively on behavioral approaches. When Claes Tingvall was appointed Director of MUARC, he introduced the concept of "Vision Zero" to Australia and, with it, the "Safe System" approach. While political leaders initially regarded a vision for zero deaths as unachievable, they supported the inherent logic of the Safe System.

Initially the Safe System was applied as four independent pillars. While this lack of integration had limitations, it did enable road safety measures to move beyond road user behavior to focus more on safer road infrastructure and vehicle safety.

The initial Safe System approach became "Towards Zero" an approach that accepts humans are fragile, and the road system designed to protect from death or serious injury was adopted across all Australia jurisdictions between 2004 and 2018.

Public education has been used to introduce and explain Towards Zero and bring greater attention to the importance of purchasing a safe vehicle. Infrastructure investment has moved from a "blackspot" approach to the Safe System approach. However, shifting community and decision-makers' understanding of the importance of speed limits being set to match the safety standard and design of a road remains a challenge. Future opportunities involve better integration of the components of the Safe System, focusing on serious injuries and improving strategy delivery, performance reporting, management, and accountability.

**Keywords**

Towards Zero · Safe System · Road Safety Strategy · Road Infrastructure Investment · Drink Driving Case Study · Vehicle Safety · Speed Management

## Introduction

The aim of this chapter is to chart the progress of the Vision Zero approach across Australia. To do this, it is important by way of background to understand a little of the country's governance structure.

In January 1901, the Australian colonies united to become a nation, with the colonies becoming Australia's six states. Through this process of federation, the British Parliament passed legislation allowing the six Australian states to govern in their own right as part of the Commonwealth of Australia. While regulatory powers with regard to road-based vehicles rested with the Commonwealth, powers with regard to traffic law and penalties, driver licensing, vehicle registration, road infrastructure, traffic management, and planning (with the exception of large, joint projects) sat with each state. This has meant developments that influence road safety outcomes have to some degree evolved differently across state boundaries. The collaborative process across states has also meant that there are significant areas of commonality.

The approach to this chapter, then, is to focus on development of the Vision Zero approach within the State of Victoria (the home state of the chapter's authors) while drawing attention to the main areas of commonality and departure across jurisdictions.

## The Years Before Vision Zero

### Early Years

Road transport across Australia evolved in a relatively haphazard way. With the introduction of motorized transport, emphasis was placed on providing roads and streets in areas of high population concentration and arteries to connect the major towns. The demand for roads far outstripped the system thinking needed to ensure that the network was efficient and safe for all road users. Professor Ian Johnston reinforced this view by stating, "We evolved inappropriate policies, practices and designs from an unmotorised era of personal transport because we had nothing else to go on and struggled to react to the rate of growth" (Johnson 2015).

In the 1940s and 1950s, the appetite for owning personal transport was fueled by population growth, as well as the novelty, convenience, and efficiency offered by the private motor car. The relatively slow development of public transport and the long distances that separated major population centers also added to the appeal.


Bourke Street, Melbourne CBD, 1950

Scientific knowledge to guide safe development of the road traffic system grew slowly until the late 1960s. According to Johnson, the next decade saw "the discipline of 'traffic safety science' [emerge] – not a science in its own right but a confluence of the disciplines of epidemiology, public health, engineering, psychology, mathematics and statistics, and trauma medicine" (Johnson 2005). Trauma medicine provided an important impetus for introducing key safety policies by identifying severe injury types associated with unrestrained vehicle occupants and alcohol-related crashes. These findings, together with a rising road toll, galvanized bipartisan support for an agenda for change (Johnson 2015).

## Safety in the 1970s and the Haddon Matrix

The 1970s heralded a move to develop the scientific evidence to support well-founded, effective safety policy. The Haddon Matrix (Haddon 1968; Haddon 1972) provided one of the earliest systematic frameworks through which to assess the safety contributions of key elements of the traffic system along a crash timeline (refer below). Under this epidemiological approach to road safety, discrete injury factors were systematically examined in order to identify which countermeasures could be implemented, often guided by benefit-cost analysis. At the same time, the first major in-depth accident study in Australia was conducted by the Road Accident

Research Unit at the University of Adelaide (Roberston et al. 1966). Increasingly, the disparate but related elements that give rise to crashes and subsequent injury outcomes were coming under investigation.

**Haddon's Matrix**

| | | Factors | | |
|---|---|---|---|---|
| **Phase** | | **Human** | **Vehicle/ Equipment** | **Environment** |
| Pre-crash | Crash prevention | Information, Attitude, Police enforcement | Roadworthiness Speed m/m, Lighting | Road design & layout, speed limit, pedestrian facility |
| Crash | Injury prevention during crash | Use of restraints | Occupant restraints, crash protective design | Crash protective roadside objects |
| Post-crash | Life sustaining | First aid skill, Access to medics | Ease of access Fire risk | Rescue facilities |

Source: Haddon 1968

## Behavioral Approaches Predominate Throughout the 1970s, 1980s, and 1990s

Despite increasing exploration into the multiple factors that contributed to crashes and injury, behavioral approaches to implementation remained the norm. Legislative reform, public education, and police enforcement were widely adopted by road safety agencies across Australia in the 1970s and 1980s.

In the early 1970s, the State of Victoria had the poorest road safety performance nationally. Victoria recorded the highest number of lives lost in a year in 1970 with 1061 deaths (equating to a rate of 31 deaths per 100,000 population). Landmark reforms addressing compulsory seat belt wearing and drink-driving were introduced in response. Stepped-up enforcement together with promotional support saw these reforms provide a strong platform for shifting key high-risk behaviors, to achieve the adoption of more protective behaviors and norms across the population.

Legislative change introduced throughout the 1970s, 1980s, and 1990s included:

- Compulsory Seat Belt Wearing

  Victoria's first compulsory seat belt law was introduced in 1970 and applied to all occupants where a seat belt was fitted. Following this, further measures were introduced to mandate availability of belts in the rear seat upon resale of a vehicle.

By 1972 all other Australian states and territories introduced compulsory seat belt wearing laws for front seat occupants (Jessop 2009). An evaluation published in 1977 reported that seat belt legislation had effectively reduced the number of deaths and injuries by approximately one-third for car occupants involved in motor vehicle crashes (Trinca and Dooley 1977).

- Bicycle Helmet Wearing

  In Victoria, public education about wearing a helmet while riding a bicycle began in 1983. There were some improvements in wearing rates among primary school-aged children, but the uptake was lower among older children and adult cyclists (Vulcan et al. 1992). In 1990, Victoria was the first jurisdiction in the world to introduce compulsory bicycle helmet wearing for anyone riding a bicycle. Evaluations showed an increase in helmet wearing and reductions in head injuries (Cameron et al. 1992b).

- Speed Management

  As speed management emerged internationally as a crucial trauma prevention strategy, speed compliance remained a challenge with general policing capacity. Development of an automated speed surveillance system using a few speed cameras in the late 1980s led to the first large-scale speed camera program in the world (Cameron et al. 1992a). Progressive introduction of 54 speed cameras and an automated Traffic Infringement Notice penalty system increased detection of speeding drivers from 20,000 per month to 40,000–80,000 per month. Combined with an intensive statewide TAC mass media campaign, the camera program significantly reduced casualty crashes and their severity, particularly across arterial roads in Melbourne and on 60 km/h roads in rural Victoria where the majority of the speed camera operations occurred. Public education focused on the difficult task of building a dialogue with community around the legitimacy of speed enforcement, as well as building a community agenda about speeding and safety (Cameron et al. 1992a).

- Drink-Driving

  Despite Victorian laws introduced in 1966 requiring drivers to have a blood alcohol concentration (BAC) limit under 0.05, drink-driving was rising in the community. In the mid-1970s, around 50% of all drivers and riders killed had an illegal BAC. As a consequence, Victoria introduced a radical new law in July 1976 that would permit random breath testing of drivers at the roadside. This law then provided the impetus for progressively increased and highly visible random breath testing from the mid-1970s and throughout the 1980s. Mass media campaigns educating the public about the level of enforcement and the increased risk of detection created a strong deterrent effect. By 1990, random breath testing (RBT) had increased to 500,000 tests annually, supported by bursts of mass media publicity and a series of legislative reform aimed at behavior and social change (South 1990; Cavallo and Cameron 1992). Experimentally designed evaluations found trauma reductions during intensified periods of RBT. As a result, the number of tests rapidly doubled from 500,000 to 1 million annually through bus-based RBT. This, combined with intensive TAC mass media campaigns, resulted in 19–24% fewer fatal crashes and 15% fewer serious casualty crashes in high alcohol times (Cavallo and Cameron 1992).

**Change Case Study: Drink-Driving in Victoria**
Victoria's drink-driving strategy has been evolving since the late 1970s, combining legislative, policing, and public education activity designed to influence behavior change. The timeline below includes milestones and data outlining the progress made over the past 50 years (sourced from a range of papers: Vulcan and Cameron 1997; Moloney 1995; South 1990; Healy 1997; Cavallo and Cameron 1992; Victoria Police 2016; McIntyre et al. 2011; Watson et al. 2015). The behavioral approach can be characterized by understanding the nature of drink-driving behavior, patterns, perceptions, and risks and progressive targeting of legislative reform where elevated risk demanded. This approach was complemented by an escalating level of enforcement activity capitalizing on new technology and equipment, coupled with public education to further enhance the perceived risk of detection. In parallel, separating drinking and driving has increased in focus through the expanded use of alcohol ignition interlocks and community education.

| Year | Measures | Level of trauma |
|---|---|---|
| 1966 | Victoria introduces 0.05 BAC limit | |
| 1976–1980 | Random breath testing (RBT) introduced at designated breath testing stations<br>Approximately 40,000 RBTs conducted<br>Increase in tax on alcohol | ~50% of drivers killed had BAC over 0.05 |
| 1981–1988 | Police adopt electronic alcohol detection devices – "breathalyzer" technology<br>Zero BAC limit for learner drivers and first- and second-year probationary drivers<br>Mandatory license cancellation escalating with BAC<br>Immediate license suspension for drivers over 0.15 BAC | ~38% of drivers killed had BAC over 0.05 (Cavallo and Cameron) |
| 1989–1999 | Police branch established with sole purpose of conducting RBT<br>Roll out of 13 highly visible "booze buses" for RBT<br>"Drink Drive Bloody Idiot" advertising campaign launched in December<br>Number of RBTs increased to almost 1 million<br>Total of 12 advertising campaigns targeting drink-driving | ~25–30% of drivers/ motorcyclists killed had BAC over 0.05 |
| 2000–2010 | Approximately 1.5 million RBTs conducted<br>Alcohol interlocks for repeat offenders, followed by high BAC first offenders<br>Advertising becomes more pointed, focusing on those "only a little bit over"<br>The zero BAC requirement for young probationary drivers extended to four years | ~20% of drivers/ motorcyclists killed had BAC over 0.05 (TAC, May 2010) |
| 2011–2019 | Expansion of alcohol interlock program to more offenders and by 2019 to all offenders<br>Approximately 3–4 million RBTs per year<br>Advertising shifts focus on separating drinking and driving<br>Mandatory license bans, interlocks, and completion of behavioral change program for all drink-driving offenders | ~18% (avg 2015–2018) of drivers/motorcyclists killed had BAC over 0.05 (Austroads) |

Legislative reform, generally high levels of enforcement, and ongoing public education were successful in changing some highly problematic, pervasive behaviors and significantly reduced road trauma from the record highs of the early 1970s. Seemingly, the principle underlying the adopted approaches was that "behavioural problems require behavioural solutions," and this proved successful when levels of serious crashes involving deliberate behaviors were high. However, there remained significant numbers of crashes leading to serious trauma that were not being addressed. In particular, the 1970s and 1980s saw little progress in reducing the high travel speeds across Australia, in recognizing the relationship of travel speed with the quality of road infrastructure, and in improving the relatively poor safety standards of the Australian vehicle fleet.

### Establishment of MUARC

Throughout the 1980s, safety problems and solutions were progressively identified and devised, drawing upon the findings of Safety Science and subsequent evaluative work that helped to refine and guide future countermeasure pathways. Safety Science received a boost in 1987 with the formation of the Monash University Accident Research Centre (MUARC) with the support of the Victorian Government. Importantly, the remit of MUARC was to support government, industry, and the community to devise and introduce effective safety measures to reduce accidental deaths and injuries in all settings by marrying academic excellence with practical significance. The Centre's aim, therefore, differed from that of many university faculties in that it was grounded in practical outcomes in collaboration with key stakeholders. Similar developments had taken place in other jurisdictions with high-quality safety centers having been already established within the Universities of Adelaide and New South Wales together with Curtin University in Perth. A new safety center was later established at the Queensland University of Technology in 1996.

## The Beginning of Towards Zero

### Moving Beyond Behavioral Approaches

Despite the significant focus on influencing driver behavior to achieve reductions in road trauma, some Australian road safety professionals were beginning to identify the relationship between decisions regarding the road transport system and questions of risk and morality. Professor Soames Job posited that "*many fatalities occur not because of driver error but because of driver error combined with a negligent designed road system and a politically acceptable but technically substandard vehicle*" (Job et al. 1989).

The most significant catalyst for the adoption of the Vision Zero philosophy in Australia was the arrival of Professor Claes Tingvall, a Swedish road safety expert who was appointed Director of MUARC in 1998. In November of that year, Prof. Tingvall introduced Vision Zero as a new paradigm for injury prevention at the

Australasian Road Safety Research, Policing and Education conference in Wellington, New Zealand (Tingvall 1998).

A year later, Prof. Tingvall together with his MUARC colleague Dr. Narelle Haworth published a paper recommending that Victoria adopt a Vision Zero approach to road safety (Tingvall and Haworth 2000). They advised that the only way to radically reduce or eliminate deaths and serious injuries was to lower vehicle travel speeds and gradually align speeds to the inherent safety of the road system. Lower maximum speed limits for differing types of road infrastructure were recommended, assuming best practice vehicle safety design and 100% restraint use.

In parallel, with a view to providing a beacon into the future and with the support of Prof. Tingvall, the world-first TAC SafeCar project was established in partnership with MUARC and Ford Motor Company (Regan et al. 2001). The aim of the project was to showcase and evaluate human performance with regard to the operation of multiple intelligent transport system (ITS) safety technologies installed within a vehicle. Technologies included haptic Intelligent Speed Adaptation (ISA), forward collision warning, and seat belt reminder systems.

## Introducing Vision Zero and Safe System to Victorian Decision-Makers

Many road safety researchers and practitioners who were exposed to Prof. Tingvall's explanation of Vision Zero were very engaged with the possibility of adopting the approach. In 2003, Eric Howard, General Manager of Road Safety at VicRoads (the Victorian Government's lead road safety agency), undertook a study tour to Sweden to learn more about Vision Zero. Upon his return to Victoria, Mr Howard shared the concept with senior leaders in Victoria and encouraged the adoption of developing a safe systems approach to road safety and committing to Vision Zero.

Mr Howard and his colleagues at the TAC worked to move Vision Zero beyond research and into a political arena and tried to have the Victorian State Government adopt his approach. However, a key sticking point was the premise of reducing speed limits to align with the inherent safety of the road network. Lowering speed limits is a highly contestable road safety issue with the broader Australian community and one that Victoria's political leaders at the time were not willing to address. According to Mr Howard, "*the lead road safety practitioners in Victoria understood the logic of 'Safe System' and the importance of committing to achieving zero deaths and serious injuries. However, convincing political leaders of the need for lower speed limits was a bridge too far*" (personal correspondence, 14 February 2020). The full adoption of the Vision Zero approach was subsequently rejected by policy-makers.

Instead, Victoria's road safety leaders decided to adopt the Safe System as the basis for its strategic approach to road safety in late 2003. While this approach raised the fundamental question of how much trauma the community was prepared to accept on our roads, it did not specifically adopt a vision for zero deaths and serious injuries

(Howard 2004). Government endorsement of the Safe System approach and the ensuing Arrive Alive Victorian Road Safety Strategy in 2007 signaled an "in principle" acceptance of the paradigm shift in road safety thinking, research, and strategy. However, full realization of the approach through implementation of safety improvements faithful to the new paradigm was not achieved over the life of the Strategy.

### Use of Safe System Across Australia

As well as Victoria, Western Australia adopted the Safe System approach early on. Iain Cameron, General Manager of Road Safety in Western Australia, together with his Victorian counterpart Eric Howard, were involved in a number of international projects that exposed them to Safe System and Vision Zero thinking. As a result, Western Australia's Road Safety Strategic Plan for 2003–2007 was underpinned by the Safe System philosophy. Like in Victoria, the actions of the Western Australian government in the early years were concentrated on behavior management, especially speed limit compliance. But unlike Victoria, there was not the significant investment in safe road infrastructure. The Western Australian approach evolved with the establishment of a Parliamentary Reference Group to socialize developments in road safety among decision-makers, and a program of consultations with industry and community was introduced to further build understanding and support for the Safe System approach (Mooren et al. 2011). Iain Cameron reflected that "*the shift to a safe system is a social, political and professional challenge, not a technical or economic one*" (Cameron 2016).

Most other Australian states gradually adopted a Safe System approach to underpin their road safety strategies between 2003 and 2010. In 2004, the Safe System approach was adopted by Austroads (a collective of Australian and New Zealand transport agencies representing all levels of government) as a framework to guide road safety research programs and a prominent guiding principle in the draft National Road Safety Action Plan for 2005–2006.

## Implementing a Safe System in the 2000s

### Early Implementation of Safe System

While Victoria and other Australian states were quick to adopt the Safe System approach, its implementation fell short of the ideal. The ethical underpinnings of Vision Zero, which sought to place human health and well-being above all other considerations and acknowledged that the road system should be built to accommodate human failings, were not at the heart of the Australian approach. Rather, a simplified "four pillar" interpretation of the Safe System was quickly adopted. Often referred to as "RSVP" (Roads, Speeds, Vehicles, People), this approach saw actions developed under each of the four pillars (see the diagram below). However, the interactions between the pillars were rarely considered, meaning that the road network could not be considered a true system. In addition, not all measures were consistent with the Safe System philosophy.

However, use of the four pillar interpretation of the Safe System did have the advantage of road safety agencies balancing more of their actions across all components of the Safe System. This resulted in far greater emphasis on vehicle safety and Safe System infrastructure and less reliance on behavioral measures than had been seen previously.


A "fifth pillar" addressing post-trauma care is prominent in the application of the Safe System approach in other countries. However, it receives less focus as a road safety pillar in Victoria due to the establishment of the Victorian State Trauma System in 2000, following a major review of trauma and emergency services conducted in 1999 (Victorian Department of Human Services 1999). At the heart of the new system were triage and transfer guidelines that ensure the right patient is delivered to the right hospital in the shortest time. In particular, severe trauma victims across the State were to be transferred to one of the three specialist trauma hospitals based in Melbourne to ensure appropriate triage and expert treatment. Operational and financial support for the Victorian State Trauma System largely came from the Transport Accident Commission (TAC).

The outcomes of this support and other initiatives are captured within a study by Gabbe and Lyons (2015). From July 2001 to July 2011, the Gabbe study investigated the burden of road transport-related trauma in Victoria using a variety of measures of mortality and morbidity. Since the introduction of targeted investment in trauma care systems in Victoria, the annual health cost burden of road transport-related serious injury decreased from AUD$1.85 billion to AUD$1.34 billion. The study also demonstrated that while "there was a significant reduction in the incidence of death and an increase in the incidence of hospitalised major trauma over the ten years, there was a rapid and sustained reduction in risk-adjusted mortality for hospitalised road-related major trauma," with the overall disability-adjusted life year (DALY) burden of serious injury falling by 28% over that ten-year period.

The TAC's support for the Victorian State Trauma System provides ongoing funding for trauma research activity such as neurotrauma research to provide sophisticated tools for ambulance care. For example, one such activity piloted the cooling of spinal injury patients to both decrease the severity of damage and extend the time window for likely effective treatment beyond the time for transfer to specialist care. TAC also supported the establishment and operation of an effective Victorian State Trauma Registry (VSTR) and currently supports the ongoing operating costs for data collection (including monitoring of patient outcomes at 6-, 12-, and 24-month intervals after the crash).

## Advancing Vehicle Safety

In the early 2000s, vehicle safety was given attention by road safety agencies for the first time. The Australian passenger vehicle fleet was one of the oldest in the developed world. In addition, many of the vehicle safety features commonly installed in European and North American vehicles were not available on the same models sold in Australia. Across Australia, programs promoting the Australasian New Car Assessment Program (ANCAP) and Used Car Safety Ratings (UCSR) produced by MUARC were developed. Following the establishment of US NCAP in 1978, ANCAP published its first ratings in 1993 and was the first NCAP to conduct a frontal offset crash test. Euro NCAP was to publish its first star ratings in 1997.

The establishment of ANCAP and the production of UCSR were of great significance in promoting the importance of purchasing safe cars across Australia. The aim of these programs was to encourage car buyers to choose the safest car they could afford and to expose the practices of vehicle manufacturers selling vehicles with lower crash safety ratings and fewer safety features than those in North America and Europe. ANCAP safety ratings posited safety as a focal point of competition and promotion for vehicle manufacturers, as was occurring in other parts of the world (McIntosh 2008).

In Victoria, a major mass media campaign and website (howsafeisyourcar.com.au) was launched in 2001. The television campaign introduced the message that "*Not all cars were created equal*" and compelled Victorians to buy the safest car they could afford by searching on howsafeisyourcar.com.au. This campaign encouraged greater consideration of safety among consumers' vehicle purchase decisions and over time assisted in some key safety features such as electronic stability control (ESC) and sidehead protecting airbags being more commonly available and eventually being mandated. The commencement of promotional activities and public education campaigns was associated with an increase in new vehicles sold in Victoria with ESC and curtain airbags, rising from 22% and 24% in 2006 to close to 60% and 50%, respectively, by 2009. Importantly "*public awareness and demand for these safety features encouraged the Victorian Government to mandate ESC in new vehicles sold in Victoria*" (Truong et al. 2010).

## Investing in Safe Infrastructure

The early 2000s also saw infrastructure being considered more specifically as a road safety measure across Australia. Treatments such as flexible barriers and roundabouts (which were already in use) were being encouraged as best practice, while measures such as creating clear zones and concrete barriers were phased out.

The TAC in collaboration with VicRoads began investing in safe road infrastructure in Victoria in the early 1990s, commencing in 1992 with an AUD$85 million “blackspot” program designed to address sites or lengths of road with high casualty crash numbers (early criteria meant a site needed a minimum of five fatal or serious injury crashes to be considered for funding). By the early 2000s, it was recognized that by targeting crash clustering at specific high-risk locations, the blackspot approach had been highly successful in reducing fatal and serious injuries at treated sites. However, it was failing to address the broader dispersion of crashes and, thus, was not creating a safe road network. After evaluating many of the blackspot treatments under early TAC-funded programs, traffic safety consultant Dr. Bruce Corben concluded that “*results from successive evaluations indicated a need to modify the treatment approach and move from a focus on high crash concentrations to treating more spatially disperse route problems*” (personal correspondence, 10 July 2020).

Environmental scans of international best practice revealed new ways of thinking about the road system. Specifically, the underlying risk and energy across the road system needed to be managed systematically, together with the specific sites where injury crashes clustered. Infrastructure treatments needed to be applied in areas where higher speeds were to be retained, while reduced speeds were appropriate in areas where the installation of tailored Safe System measures would be highly cost-inefficient. Both approaches were concerned with managing system energy such that death or serious injury would not arise. This thinking and practice was not occurring in Australia at this time. Against this background AusRAP internationalized with partner agencies such as IRAP and established a valuable service in providing guidance nationally for investing in road and roadside infrastructure via a star system that rated the risk of the main road network across Australia (Smith et al. 2006). While five stars was the ultimate goal, three stars or better was deemed to be an appropriate performance target.

In 2002, the TAC in collaboration with VicRoads commenced investing in infrastructure treatments through its AUD$130 million Safer Roads Infrastructure Programs (SRIP1). Treatments addressed run-off-road and intersection crashes, the two key crash types seen in Victoria. Long-length flexible barrier treatments and roundabouts were installed to more systematically address fatal and serious injury crashes. Successive SRIP programs (SRIP2 and SRIP3) invested a further AUD$760 million in infrastructure treatments between 2004 and 2016. However, these treatments were a mixture of Safe System treatments and more conventional blackspot-style treatments.

Transitioning Victoria to the systematic rollout of Safe System infrastructure required engagement and coordination from all parties involved in planning, design, and delivery of road infrastructure. Initially, this proved very difficult. In presentations to the Victorian road safety fraternity, Alavi (2019) noted numerous barriers to fully implementing the Safe System approach in the Australian context, including the limited incorporation of Safe System and Vision Zero thinking in current standards and guidelines, and in network and town planning practices. In addition, conventional standards, procedures, and processes were counterproductive to planning investments, as well as to developing, delivering, and evaluating projects. Moreover, investment in Safe System infrastructure was further hampered by a lack of available training in universities and an absence of graduate programs for road safety professionals.

Australian engineers had been trained to work within decades-old standards that guided thinking towards conventional safety treatments, thus creating a barrier to transitioning to planning for a network, designing treatments that aimed to eliminate rather than reduce injury and crash types, and addressing roads and sites that had not yet recorded serious injury crashes.

The development of a new Victorian Road Safety Strategy along with further investment via the Safe System Road Infrastructure Program (SSRIP) saw conventional blackspot treatments finally transition into a program that systematically treated the road network in late 2013 through until 2015.

The key differences from SRIP3 to SSRIP were:

(a) Transition from conventional safer road treatments to Safe System treatments
(b) Safe System transformation of some high-risk high-volume highways linking key major towns to Melbourne
(c) Trials of innovative treatments such as 2 + 1 roads and vehicle-to-infrastructure communication technologies
(d) Consideration of lowering of speed limits and other traffic calming measures where cost-benefit calculations see other treatments being unaffordable

Similarly, in urban areas where infrastructure investment would prove to be cost-inefficient, safe speeds were advocated, but no wide-ranging review of speed limit setting was recommended. Reduced 40 km/h limits, however, continued to be supported in locations where vulnerable road users congregated including outside schools, in busy shopping centers, and across the Central Business District (CBD) of Melbourne.

In recent times, the only default speed limit to change in Victoria was the reduction in 2001 of the built-up environment speed limit from 60 km/h to 50 km/h. Other states had introduced, or were to introduce, a similar change to the default speed limit in built-up areas.

The transition towards the Safe System was facilitated through the development of engineering tools and the publication of national practitioner guidance on road safety infrastructure, such as Austroads (2018). Victoria adopted Safe System Assessment Guidelines for all VicRoads and government-funded projects "*to assist planners, designers and project managers to progress the Safe System approach from theory to practice of determining how well a project proposal aligns with Safe System principles*" and "*information on design and scope changes that will move a project proposal closer to the Safe System objective of eliminating the risk of fatalities and serious injuries*" (VicRoads 2019).

The graph below maps the number of lives lost on Victorian roads since 1970 with some of the significant policy and programmatic measures introduced to reduce road trauma.

## Towards Zero

### Adopting the Vision Zero Principles

The Safe System approach continued throughout Australia during the early to mid-2000s. Jurisdictions such as Victoria had undertaken study tours to Europe to understand how some of the best performing countries such as the Netherlands, Norway, and Sweden were achieving their impressive reductions in fatalities. The more principle-based Vision Zero approach was increasingly being understood and coveted by Victorian road safety professionals. However, it was not gaining any traction within the community nor with governments, local government authorities, or the corporate sector (TAC Social Research Centre 2013).

In 2013–2014, Victoria started to consider how it could better adopt and socialize the Vision Zero principles within the community. The key was to address two long-held beliefs among some of those working in road safety and more broadly within the community. The first belief was that it was inevitable, and thus accepted, that Victoria would always have a "road toll." The second belief, somewhat related to the first, was that most crashes resulted from people taking deliberate risks and "*doing stupid things*" (Truong et al. 2015).

In setting an ultimate goal of zero deaths, it was deemed important to educate the community that most road deaths in Australia (an estimated 57%) were related to simple human error or mistakes which the system failed to accommodate (Wundersitz and Baldock 2011). Via this path, road safety agencies hoped to not only gain community support but also stimulate a greater desire by road network planners and designers to think longer term about eliminating rather than reducing deaths on Victoria's roads.

### Adopting Towards Zero

The use of "Towards Zero" as the brand or name for Victoria's further adoption of the Vision Zero approach came about through market research undertaken to develop supporting public education campaigns. Victorians felt that "Towards" was inspirational and implied actions would be taken to push the State forward to reach the ideal of zero road deaths. In comparison, they felt "Vision" implied an ideal or aspiration but not a solid plan.

Alongside the public education campaign, individual road safety agencies undertook their own actions to socialize the Towards Zero approach. At an academic level, MUARC commenced a five-day Road Safety Leadership Program available internationally but used extensively by road safety agencies across

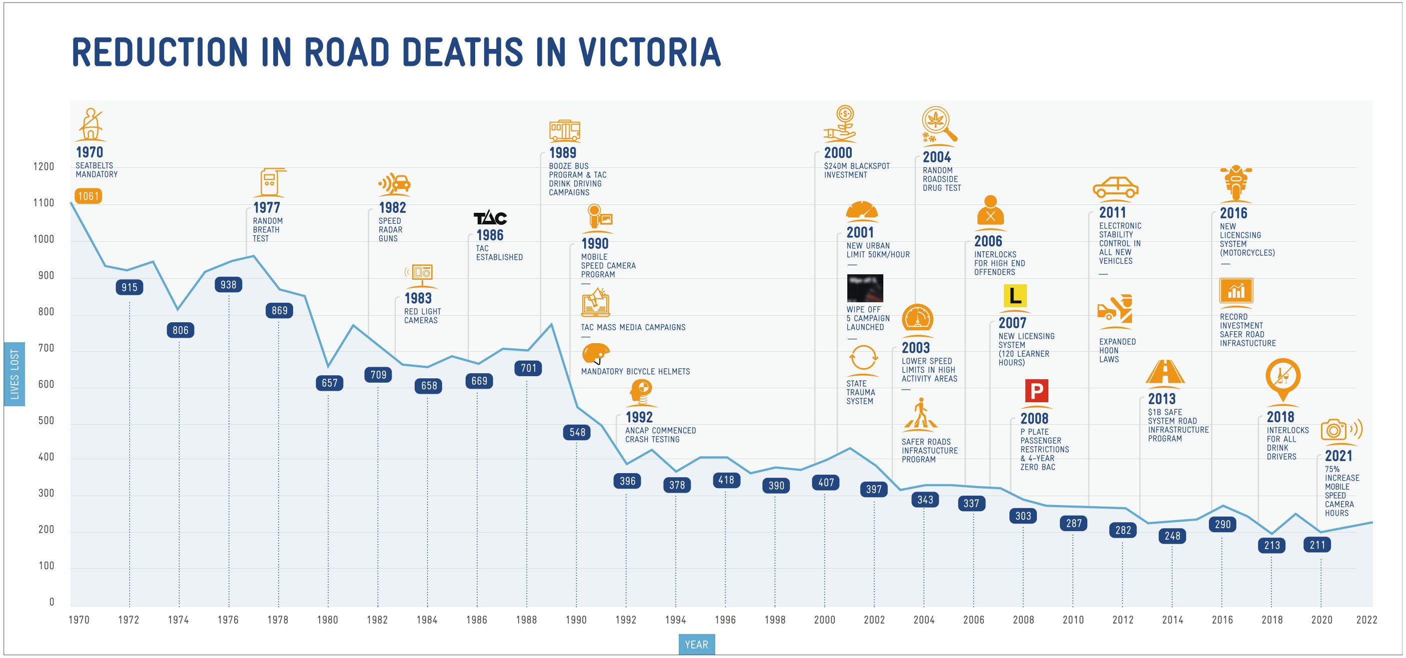



**Fig. 1** Road deaths and landmark road safety initiatives in Victoria, Australia Source: Transport Accident Commission

Australia to induct and develop their people. VicRoads refined the MUARC leadership program into a tailored two-day embedment program for all its executive staff. The TAC developed on online learning program that was undertaken by its entire staff and was provided to VicRoads, police, and other agencies to educate their staff. This online learning program has since been used by local government and corporate organizations to create understanding about the Towards Zero approach (Waller and Cockfield 2014).

Towards Zero gained its greatest momentum and acceptance in Victoria with the development of the Towards Zero 2016–2020 Strategy and Action Plan which was endorsed by the Government and sought to further embed some of the key aspects of the Vision Zero approach. Key features of this Strategy included:

- Explicitly endorsing the ultimate aim of eliminating death and serious injury on Victoria’s roads
- Clear interim targets for reducing trauma as steps towards the ultimate aim of zero trauma and explicit use of the Safe System approach to reach interim targets
- Adoption of three guiding truths – acceptance of human fallibility, limits of the human body’s physical vulnerability to crash forces and impact speeds, and shared responsibility for safety of the road system
- A plan for a systematic network-wide approach to address the key risks faced by road users, specifically:
  - By looking to a systematic roll out of Safe System infrastructure with a goal to gradually treat all high-volume, high-speed roads with flexible barrier treatments
  - Provide interim treatments on medium-volume roads together with speed moderation on low-volume roads in rural and urban areas
  - Complemented by traffic calming and greater separation of active transport movement from motorized traffic
- Community engagement to build understanding of safe speed
- A greater focus on technology to address behavioral issues
- The Victorian Government’s introduction of a 5-star purchase policy for its fleet vehicles, with local government authorities and corporate Australia encouraged to become involved

In terms of implementation, not all treatments would be fully Safe System to start, but over time the plan combined large-scale investment in infrastructure with location-specific speed limit reviews being considered for low-volume roads which infrastructure investment wouldn’t reach for some years.

However, managing speeds to safe levels consistent with road function and infrastructure treatments across the road network remains a challenge. Within urban areas some gains have been made at specific locations – 40 km/h limits now apply in several local government authorities, outside schools, along busy shopping centers, and within the CBD. A more broad-based systematic approach to speed limit adoption that recognizes human tolerances to injury under differing road and roadside conditions is yet to be realized.

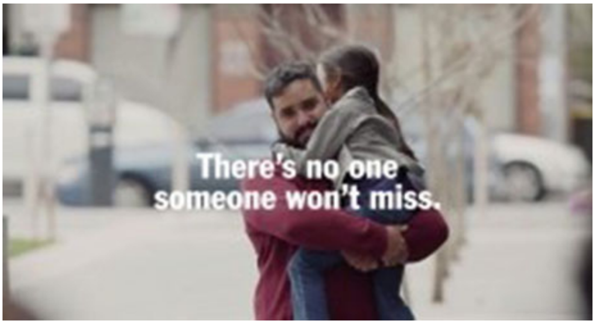
## Public Education and Towards Zero

Under the Towards Zero strategy introduced in 2016, the TAC has also used mass media public education to set the agenda around key principles of the Vision Zero approach, aiming to:

- Challenge the community to think about the acceptability of death and injury on the roads
- Educate the community about human vulnerability
- Inform the community about the value of Safe System road infrastructure and vehicle safety

Specifically, three public education programs relate directly to Safe System concepts:

- *Man on the Street* – a campaign that asks the public to consider if it is acceptable for people to die or be seriously injured on the roads
- *Graham* – an artwork installation that illustrates human vulnerability by portraying what our bodies would have to look like to survive crashes
- *Safety Barriers Save Lives* – mass media campaign demonstrating how flexible barriers work to help build understanding and support for their implementation




TAC Man on the Street Campaign


'Graham' art installation

In 2018, the TAC opened the Road to Zero Education Complex within the Melbourne Museum. The aim of the Education Complex is to engage and empower young people, road safety stakeholders, and the broader Victorian community in understanding what we need to do to achieve Towards Zero's vision of a future where no one is killed or seriously injured on our roads.

Drawing upon road safety evidence and educational research, the complex was co-created with young people and Victorian road safety and education experts. Road to Zero features:

- A permanent interactive exhibition (open to visitors) that explains the key tenets of Towards Zero
- A curriculum-based education program for secondary school students
- A mobile "pop up" exhibition to visit rural and remote communities
- Programs for other road user groups and road safety practitioners

The intention is that the Road to Zero Education Complex will operate, in partnership with Museums Victoria, until at least 2028. In 2019, over 70,000 people visited the interaction exhibition, and 11,000 young people completed road safety education programs at the Complex.

Road to Zero Exhibition, Melbourne


Speed and Crashes – Road to Zero

## Community Support for Towards Zero

Survey research shows that 87% of the community agrees that Victoria should aim for zero road deaths. However, the high level of in-principle support does not translate into the belief that the zero target is achievable, held by only 18% of the community (TAC 2019).

Over the past three decades, behavior change campaigns have educated the public about road safety risk. Victorians look to the behavior of individuals as the “problem” requiring intervention for improvements in road safety. Surveys show that distracted drivers, drink-driving, and speeding are the road safety issues which are of most concern to Victorians (TAC 2019). Unsafe roads and vehicles are cited by far fewer as issues of concern. Victorians believe that how people drive is more important in saving lives than road design (TAC 2019).

However, there is public support for investing in infrastructure. On average, survey participants asked to allocate $100 to road safety interventions thought that $31 should be spent on roads, $27 on police enforcement, $23 on public education, and $19 on treatment for drug and alcohol addiction (TAC 2019). Encouraging the public to look beyond “blaming” driver behavior and to instead understand the contribution of the wider system remains a challenge.

## Adoption of Towards Zero Approach Across Australia

Across Australia there are signs that positive steps are being taken in adopting the Vision Zero approach.

In August 2019, the Transport and Infrastructure Council (TIC) reported that they were "*strongly committed to developing the next National Road Safety Strategy based on a target of zero fatalities.*" They also noted that "*all investments in road infrastructure planning, design and construction will require application of Safe System principles and inclusion of safety treatments that align with these principles*." This was the first time that all states and territories within Australia had looked to plan for the long term and agreed to the adoption of an ultimate 2050 target of zero road fatalities for Australia. Importantly, the TIC defined "*the principles of a Safe System approach are: Human fallibility – People make mistakes on the road; Human vulnerability – Humans are physically frail with limited ability to tolerate the forces in a crash; and a Forgiving system – a road transport system must be 'forgiving' of mistakes within these limitations. (This) applies to all roads and investment sources*" (Australian Transport and Infrastructure Council 2019a).

Across the nation, states, territories, and cities are taking actions to realize the key principles of Vision Zero. Some specific examples are highlighted below.

- In Tasmania, the Safe System approach has been adopted, and action can be seen in its plans to upgrade the Midland Highway, its key north-south road. A combination of speed limit reductions (to 80 km/h) and barrier systems in conjunction with some low-cost tactile edge-lining is being used to make the road safe.
- The Hume Highway, Victoria's key north-south route and already a divided road, has been upgraded to be completely covered in flexible barrier systems. An early success came in 2019 when this 300-kilometer, high-volume road saw no fatalities, months before the road was fully completed.
- In South Australia, a large project aligning speed limits on rural roads to Safe System principles was undertaken in late 2011. This saw 52 roads (864 kilometers) reduced from 110 km/h to the rural default speed limit of 100 km/h. The public education campaign that accompanied the changes ensured the new speed limits were well understood and supported (Dua et al. 2013).
- Also in Victoria, some local government areas are making great headway. The City of Melbourne implemented a 40 km/h speed limit for the CBD in 2012, and in 2019 its draft transport plan outlined a program to trial lower speed limits on pedestrian priority streets also in the CBD (City of Melbourne 2019).
- Commencing in 2018, New South Wales has aligned the Towards Zero vision with Future Transport 2056, which aims to have a NSW transport network with zero trauma. It has embarked on an ambitious Road Safety Plan 2021 that included:

- Accelerated safety infrastructure investments of $820 million under "Saving Lives on Country Roads" and "Liveable and Safe Urban Communities" programs. The Plan commits to establishing road safety targets to drive the investment strategy for the state network, including targets for the proportion of travel on four- and five-star roads and the proportion of the road network with safety features, including median and roadside barriers.
- Expanded Fleet Policy with a focus on protective future vehicles to include safety features in the fleet in addition to the existing 5-star policy and new vehicle and technology testing facilities.
- Introduced lower speed zones in high pedestrian areas, a world first MotoCAP safety rating system for motorcycle protective clothing widely promoted to motorcyclists and business engaged to integrate road safety as part of work, health, and safety.
- Introduced the world's first mobile phone detection camera enforcement technology using artificial intelligence, broad-ranging drink- and drug-driving reforms including immediate sanctions upon detection and vehicle ignition interlocks for most drink-drivers, and a target of 200,000 random roadside drug tests.

• In 2018, the Queensland Department of Transport and Main Roads (TMR) developed a Road Safety Management Plan (RSMP) to embed Safe System principles and culture throughout the organization, meaning Safe Systems frameworks will be actively applied in the planning and design of road infrastructure (Peterson and Harrison 2018).
• Nationally, the Federal Government has committed to the deployment and uptake of proven vehicle technologies, looking to the UN 2022 Regulations and the World Forum for Harmonization of Vehicle Regulations (WP.29) as a guide for what could be adopted through the Australian standards (Australian Transport and Infrastructure Council 2019a).

## Implications for the Future

### Challenges Remain

The application of Safe System thinking to the road safety problem across Australia over the past two decades has given rise to significant safety gains. The continuing rollout of protective roadside and center-line infrastructure, reduced speed limits in areas of high pedestrian and cyclist concentrations, and the vigorous promotion of safer cars with passive and active safety features have all played a part. Targeted enforcement with supporting public education alongside technologies such as alcohol interlocks has served to nudge behaviors into safer forms.

And yet, across Australia over 1195 people continue to die on the roads each year, and approximately 40,000 more require hospitalization (BITRE 2020). These figures alone are stark reminders that the vision of achieving zero fatalities remains a distant aspiration and that the current road transport system remains inherently risky for the user.

## Road Safety Management

A very detailed and high profile review of the National Road Safety Strategy was conducted in 2018 (Wooley and Crozier 2018) with strong support from the Australasian College of Road Safety, a body of road safety professionals and those interested in road safety that encourages professional development and information sharing while serving as a strong advocate for change at government level (see acrs.org.au). This review escalated the urgency within government circles in attending to a number of key safety priorities. In response to the review's recommendations, the Federal Government has now established an Office of Road Safety, reporting to a designated Federal Cabinet Minister, with key responsibilities including developing a new national strategy in collaboration with states and territories.

With a view to ensuring the success of these arrangements, a recommended governance review was also undertaken to provide advice with regard to agency structure, charter, and its relationship with external partners. Stronger action was urged in relation to "road safety" becoming "business as usual" across all government departments and related bodies as well as within the private commercial sector. The authority and resources vested in the new Office of Road Safety will be critical to its success.

In relation to the development of the next 10-year national road safety strategy (2021–2030), the review further recommended that a Vision Zero target of zero fatalities be set for the year 2050, consistent with the goal set by the European Commission, and that meaningful performance indicators be developed and adopted that accurately reflect interim safety progress across a range of safety-related domains (Wooley and Crozier 2018). The review also noted that targets have been framed mainly in terms of death and serious injury tallies within defined categories, their interim results rarely giving rise to a substantive change in safety directions. Establishment of safety performance indicators for key elements of the road transport system that will drive and achieve trauma reduction targets is a critical ingredient of effective and transparent road safety management into the future.

The Australian Transport and Infrastructure Council (TIC) that brings together Commonwealth, State, Territory, and New Zealand Transport Ministers as well as the Australian Local Government Association issued official statements in August and November 2019 (Australian Transport and Infrastructure Council 2019b) that confirmed the above commitments. The TIC also stressed that the new national strategy will complement jurisdictional strategies and that responsibility or delivery will be shared across all tiers of government.

History suggests that effective realization of the above recommendations is by no means straightforward. A commitment to a Safe System approach within strategies at the national and jurisdictional levels does not guarantee its full realization in practice. Many of the key road safety responsibilities relating to transport safety and regulation rest with the jurisdictions, while the Commonwealth manages vehicle safety regulations plus funding support for key infrastructure projects. Leadership at each tier of government will be required to realize the commitments made by all Transport Ministers.

Nevertheless, actions taken to date and commitments made by federal, state, and territory governments in response to the National Road Safety Strategy Review findings represent a very promising foundation upon which to build an effective attack on serious road trauma. Achieving genuine cultural change flowing down from the national government through the jurisdictional and local government entities to operational practice reflecting Safe System thinking represents a significant multifaceted challenge.

Furthermore, given the commitment to achieve zero road fatalities by 2050, it is incumbent upon governments to shape a pathway for how this target is to be achieved and what a safe and sustainable transport system should look like in 2050. In so doing, the main external forces that will shape the future together with the key safety and transport developments that will help to achieve the safety goal need active consideration. This issue is discussed further below.

Finally, the efficacy of achieving zero road deaths by 2050 is given a boost in the eyes of system builders and the community alike by achieving staged milestones that reflect genuine progress. To this end, the TIC agreed in principle to interim targets of Vision Zero for all major capital city business centers and high-volume highways by 2030 (Australian Transport and Infrastructure Council 2019c). In the meantime, the Federal Government has introduced a Vision Zero map that presents municipalities with zero deaths over specified time periods across Australia (see the Vision Zero maps at www.bitre.gov.au/statistics/safety).

## Reporting and Accountability

The role of a strategy is to provide a blueprint for plotting an evidence-based pathway to achieving a defined goal at the end of the strategy's timespan. In the case of the new national road safety strategy under preparation, the aim is to achieve a 30% reduction in serious road trauma by 2030 on the road to its elimination by 2050. Future state and territory strategies concerning trauma targets will need to support these accordingly.

In parallel with the rollout of future national and jurisdictional strategies, a set of intermediate performance indicators needs to be established to track trauma trends at a macro level over time, to help build an understanding of progress in key aspects of the strategy's performance, and to underpin the progress made in reaching the nominated trauma target. The intermediate targets play a vital role in determining which safety programs are successful, which are not, and what adjustments are the most appropriate.

Given the very significant investment in public funds, it is incumbent upon government to be accountable and transparent in terms of progress made against targets and the future directions of implementation. Accordingly, governments need to establish mechanisms to ensure that the public is so informed and the governments are open to public scrutiny and enquiry as appropriate.

Adoption of the principles of accountability and transparency at the government level signals to the community its true commitment to achieving the desired trauma outcomes and its preparedness to accept responsibility for underperformance where relevant.

## Future Challenges and Opportunities

### How to Improve Speed Management and Road Infrastructure?

Australia has one of the largest networks per capita anywhere in the world, with a road network stretching more than 877,000 kilometers. Australians are very car dependent, with 75% of all passenger travel being road-based (Roads Australia 2020).

More than half of the roads in Australia are unsealed roads (IPWEA 2017). As many rural roads across Australia are low-standard, low-volume roads, this makes creating Safe System-compliant roads impossible through infrastructure treatments alone.

Strategically, the approach adopted in Victoria and consistent with many other jurisdictions is to invest in infrastructure treatments where cost-efficient to do so in order to maintain current travel speeds on roads that require a high "level of service." This has involved extensive flexible barrier rollout on high-speed freeways and highways. However, it is simply not financially viable to apply similar treatments to the long stretches of secondary and tertiary roads that crisscross the State. Managing speeds to within Safe System limits on these road types is likely to be the best option but in many instances remains a challenge.

All jurisdictions are facing pushback via intertwined political and sectoral community interests. In urban areas, some success has been enjoyed where speed limits have dropped at locations with high concentrations of pedestrian and cyclist activity. With some notable exceptions, neither the extensive local street system nor high-speed low-to-medium volume roads have enjoyed similar success. In this context, it is critical that revised standards and guidelines for road design including infrastructure support are linked to recommended speed limits consistent with Safe System principles. Improved design standards for roads alone do not guarantee Safe System solutions in many circumstances in the absence of harmonized speed management.

To date in Victoria, and to a large extent across Australia, speed has often been addressed as a stand-alone issue despite being linked to road function and the level of infrastructure support. Yet potentially its salience can grow as it is integrated within a broader sustainability agenda. The issues of climate change, health and well-being, reduced road maintenance, mobility, alternative and public transport, and accessibility are becoming increasingly prominent on the political and community landscape. Their mutual dependence has been little explored and promoted to date. Population growth and migration to the large cities only serve to heighten the need for sustainable solutions.

A future in which speed is integrated within a broader vision for transport holds considerable promise as a fruitful avenue for successfully promoting speed management in the context of a safe and sustainable transport system. This approach has received broad coverage and support internationally through the development and promotion of the Sustainable Development Goals (Trafikverket 2020). Aligning objectives and actions where relevant across environment, health, and transport portfolios represents an outstanding opportunity.

One area of recent progress in speed management that holds promise for the future has been the more active role of local government in agitating for reduced speed limits, especially in local streets on secondary high-speed roads. For example, speed limits are being lowered on nearly 40 roads within a large outer urban municipality of Melbourne as a two-year trial. The Western Australia government has committed to working with local government on an ongoing review of speed limits across the road network (Main Roads Western Australia 2020). In New South Wales, many local government authorities in inner Sydney have reduced urban speed limits in their municipalities to 40 km/h and 30 km/h.

Revising speed management practices to reflect Safe System principles and be more sympathetic to road quality and function ironically represents one of the least costly and most impactful road safety options, and yet receives the most resistance. There is no substitute for leadership committed to achieving a safe road transport system.

Finally, it should be noted that changing the speed limit on the vast network of secondary and tertiary roads does not in itself necessarily achieve a Safe System outcome. Increasingly, active and passive features in the vehicle fleet in conjunction with local travel speeds and infrastructure will assume greater safety importance.

## Realizing the Benefits of Safer and Autonomous Vehicles

Vehicle replacement rates are slow across Australia, with the average age of a vehicle on-road being approximately 10.4 years (Australian Bureau of Statistics 2020). In 2019 in Victoria, the average age across all vehicles involved in fatal and serious injury crashes was 13.5 years (TAC 2020).

As new vehicles replace older vehicles in the Australian fleet, passive safety features such as side curtain airbags and improved cabin integrity will improve the safety outcomes for vehicle occupants (Wooley and Crozier 2018). ANCAP has provided an important advocacy role in reporting the safety performance of new cars and derivatives entering the market to consumers and bringing forward voluntary fitment and purchase.

It is, however, the road to automation in Australia that holds the greatest promise for the future. Given the high dependence on car usage in Australia, the progressive transfer of control from the driver to the vehicle will be particularly important to address the errors humans will inevitably make as well as a vast road network which is almost impossible to make safe. In a submission to the Victorian Parliamentary Inquiry to the Road Toll, Victoria's automobile club, RACV noted, "At the current rate of funding we estimate it would take over 1000 years to upgrade every road to an acceptable safety" (Hewitt 2020).

Technologies such as automatic emergency braking (AEB) and lane keep assist (LKA) are common features of newer vehicles, with evaluations testifying to their safety impact (Fildes et al. 2015; Sternlund et al. 2017). Moreover, technologies may combine to yield an even better safety outcome – for example, ESC (electronic stability control) and AEB together stabilize the vehicle and then reduce the impact speed respectively when a driver mistake cannot be corrected.

However, the uncollected safety dividends are substantial. There is an unacceptable gap between a proven technology being available in the marketplace and stipulating it as mandatory in new vehicles as part of the Australian Design Rule process. Every vehicle that rolls off the assembly line bound for Australia without the proven safety technologies fitted is an opportunity lost. For the life of that vehicle, it will operate at an inherently elevated level of risk that could have been avoided.

We can learn much from the European Union that in 2018, through the European Commission, announced a range of new safety technologies, variously applying to cars, vans, trucks, and buses for introduction by 2022 (European Commission 2019). Encouragingly, the Australian Government committed in August 2019 to streamlining the process of instituting regulatory changes to vehicle safety standards and will endeavor to align Australian regulations with the proposed European safety package (Australian Transport and Infrastructure Council 2019a). Achievement of this commitment in the future will greatly assist in saving lives on Australia's roads.

Further, there are two areas in the early phases of implementation that can have a very positive influence on vehicle safety in the longer term. The first is shared transport or shared self-driving car services in which the government can play an active role in encouraging its adoption and guided expansion within the private sector (International Transport Forum 2015). In simple terms, shared services can require fewer vehicles with higher occupancy travelling much greater distances in less time leading to faster vehicle replacement rates. Therefore, as new safety technologies enter the market, they will penetrate and benefit the on-road fleet much more rapidly.

The second is demonstrating the efficacy, convenience, and safety of autonomous vehicles through trials conducted with technical partners. Importantly, trials help to align technology advancements and operational practice with the regulatory framework together with supporting infrastructure and communication requirements. The journey towards a fully autonomous vehicle fleet holds great promise if the safety expectations for the future vehicle are clearly and unequivocally set to prevent the patterns of trauma typified in driver-controlled vehicles. A glimpse into the future helps to galvanize action as well as build community acceptance. Safety is an integral partner in this development.

## Improved Data and Research

The value of life and health lies at the heart of Vision Zero, and leading jurisdictions have incorporated measures of injury severity and injury burden in their thinking (e.g., Risk of Permanent Medical Impairment in Sweden; see Berg et al. 2016). The focus on serious injury in Australia remains largely on hospitalization, a coarse measure of injury outcome.

A challenge in the Australian context is to better understand injury outcomes and the factors that contribute to, and which can prevent, the injury burden carried by crash-involved road users. Linkage of hospital data to crash data is required and has been achieved with some success in Western Australia and New South Wales (see Harrison et al. 2019) and more recently agreed to in Victoria following a linking of one year of data (Ziekemijjer and McIntyre 2018). An in-depth understanding of the long-lasting or permanent health impacts will allow for a more strategic approach to reducing the injury burden on the community and permit more precise measures in the future of safety performance by tracking trends over time in the most severely injured road users by categories of interest.

A constant companion of valid, reliable, and relevant data is the road safety research community. Australia is very fortunate as it has reputable, high-quality research centers in the majority of states. Resourcing a coordinated program of research and development across the safety centers with the focus firmly on advancing the practical application of Safe System principles to the road and traffic system represents a key plank in supporting effective implementation of the next national strategy. Investigations of the interrelationships between all the pillars of a Safe System deserves a strong presence in a future research program.

## Conclusion

The introduction of Vision Zero, later termed as Safe System, has had a profound influence on road safety thought and practice across Australia.

The professional communities in the government and academia have largely embraced the approach and its ethical underpinnings. Road safety strategies across Australia invariably cite Safe System principles as the approach to guide the various safety measures to be implemented. Significant safety gains have been made, thanks to rollout of protective barriers on high-speed roads, reduced speed limits where vulnerable road users congregate, and vigorous promotion of safer new and used cars. Targeted legislative reform and stepped-up enforcement with public education support have also played a part.

But the Safe System approach has been delivered in part only. The challenge of managing speeds within safety thresholds on roads and streets where infrastructure treatments are cost-prohibitive is one prime example of an undelivered initiative. A reduction of travel speeds on lower-quality roads coupled with the increased prominence of advanced active and passive safety features in the vehicle fleet will greatly assist in the elimination as opposed to reduction of serious road trauma on Australia's roads. Understanding the interrelationships across Safe System pillars is key to plotting the most cost-effective pathway into the future.

Encouragingly, the Transport Infrastructure Committee, which includes the Ministers of Transport federally and from each state and territory, has made significant commitments for the new strategy, which include:

- A target of zero road deaths in 2050 together with intermediate targets.
- All major infrastructure investments will be subject to Safe System compliance.
- The safe vehicle design rule process will be streamlined to close the gap between the safest cars operating in Europe compared with Australia.

Importantly, the principles of Safe System will be faithfully applied in developing the new national 10-year strategy.

These are promising developments, and their realization is a significant challenge to be met as the new strategy takes shape and is then rolled out.

For Australia to succeed in achieving both the interim goals and the ultimate goal of zero road deaths in 2050, there is now no substitute for political will and accountability. People's lives and health depend on it.

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# Vision Zero on Federal Level in Canada

16

Pamela Fuselli

## Contents



**Abstract**

This chapter will provide a summary of high-level details regarding Vision Zero implementation in Canada, looking specifically at research, strategies, and implementation experiences in British Columbia, Edmonton, Calgary, and Fort Saskatchewan in Alberta, Toronto in Ontario, and Montreal in Quebec. This chapter

P. Fuselli (✉)
Parachute, Toronto, ON, Canada
e-mail: pfuselli@parachute.ca



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will speak to the differences between Vision Zero implementation in Canada compared with Sweden, considering the viewpoint and circumstances of the unique governmental structure in Canada and implementation in municipalities versus entire provinces or territories. Priorities for the future of Vision Zero will also be discussed, along with the intersections and role of public health and other applications of Vision Zero.

**Keywords**

Vision Zero · Road Safety · Road Injury · Collisions · Active Transportation · Countermeasures · Speed · Distracted Driving · Impaired Driving · Aggressive Driving · Enforcement · British Columbia · Edmonton · Calgary · Fort Saskatchewan · Alberta · Ontario · Quebec · Montreal · Toronto · Sweden · Canada

## Introduction

Canada is the second-largest country in terms of land mass in the world, with a land area of 9,093,507 km$^2$ and a population of 36.9 million (Canada Facts n.d.). The governmental structure in Canada creates a unique environment for road safety and road safety countermeasures, with federal, provincial or territorial, and municipal governments, First Nations governments, and other organizations and police forces each having a say in legislation, budgeting, and enforcement related to road safety. Adopting Vision Zero takes a sense of urgency in combination with time, patience, and collaboration to be successful, and means making a public commitment to road safety, setting targets, and allocating resources. Numerous cities and provinces of various sizes across Canada, both rural and urban, have been inspired by the success of Vision Zero in Sweden and numerous other countries around the globe. Seeing what can be achieved has driven road safety advocates from multiple fields and jurisdictions across Canada to get involved in conducting research on road safety and adopting Vision Zero.

## Overview of Canada

With a wide range of geographical and weather differences, along with a unique jurisdictional framework, many facets can impact road safety. Canada has three ocean borders: the Pacific Ocean in the west, the Atlantic Ocean in the east, and the Arctic Ocean to the north (Government of Canada 2017a). Canada borders the United States in the south and in the northwest and has many different types of landscape, including: high mountains, the foothills, prairie grasslands, different types of forests, and the Arctic tundra, where the ground is permanently frozen (Government of Canada 2017a).


Picture source: Canada Facts (n.d.)

In Canada, there are four seasons: winter, spring, summer, and autumn. Winter is cold in most places, with temperatures often below zero degrees Celsius. Snow covers the ground from around December to March or April each year. In Southwest British Columbia (around Victoria and Vancouver), many winters have no snow at all but only rain (Government of Canada 2017a). Summer lasts from around June to September and the weather varies from warm to hot. Daytime temperatures are generally between 20 and 30 degrees Celsius or Centigrade (68 and 86 degrees Fahrenheit), or higher. In southern Ontario and Quebec, it can often be very humid (Government of Canada 2017a). Finally, fall and spring are transition seasons, meaning the weather starts getting colder or warmer, and there is a lot of rain (Government of Canada 2017a).

## Federal, Provincial, or Territorial Structure

Ottawa is the capital city of Canada and is located on the Ottawa River between Ontario and Quebec. Canada has ten provinces and three territories, each with its own capital city. These provinces and territories are grouped into five regions: the Atlantic Provinces (Newfoundland and Labrador, Prince Edward Island, Nova

Scotia, New Brunswick); Central Canada (Quebec and Ontario); the Prairie Provinces (Manitoba, Saskatchewan, Alberta); West Coast (British Columbia); and North (Nunavut, Northwest Territories, Yukon Territory) (Government of Canada 2017a). Most people live in southern Ontario and Quebec, Southwest British Columbia, and Alberta. Much of the north has a very low population because of the cold climate.

## Government Structures

Canada has three main levels of government: federal, provincial or territorial, and municipal and First Nations. The federal government is based in Ottawa, Ontario, which handles both national and international matters (Government of Canada 2017b). Provincial and territorial governments are the next level in each province and territory in Canada. Finally, there are municipal and First Nations governments.

The provincial and territorial governments have the power to change their laws and manage their own public lands. They are in charge of education, health care, and road regulations (Government of Canada 2017b). Further, municipal governments run cities, towns, or districts. They are in charge of parks, parking, libraries, roadways, local police, local land use, fire protection, public transportation, and community water systems (Government of Canada 2017b). Across the country, band councils govern First Nations communities. Band members elect the band council, which make decisions that affect their local community (Government of Canada 2017b).

## Road Safety Efforts Leading up to Vision Zero in Canada

While the introduction of the Vision Zero approach was an impactful step for road safety in Canada, Canada's road safety work began long before Vision Zero was first introduced. Given the plateau in road safety progress in the mid-1990s in Canada and the desire for improved cooperation among Canada's road safety stakeholders, experts from various levels of government, nongovernmental organizations, and other key stakeholders participated in a national forum on road safety. The forum led to the creation of Canada's first national road safety plan, called *Road Safety Vision (RSV) 2001*, in 1996 (Canadian Council of Motor Transport Administrators 2013). Canada was one of the first countries to implement a national road safety strategy, and since the introduction of the *RSV 2001,* three national strategies have been adopted (Canadian Council of Motor Transport Administrators 2016). During *RSV 2001*, Canada saw a 10% decrease in fatalities and a 16% decrease in serious injuries, despite an increase in road user population (Canadian Council of Motor Transport Administrators 2016).

The second strategy, *RSV 2010* was approved by the Council of Ministers in 2001. The vision and strategic objectives were based on *RSV 2001* and included a national target and sub-targets. The targets provided road safety stakeholders with key road safety indicators to measure the impact of intervention efforts (Canadian Council of Motor Transport Administrators 2016). The national target was a 30% decrease in the average number of road users killed and seriously injured from 2008 to 2010 compared to 1996–2001, with an aim to reduce Canada's road fatality total to less than 2,100 by 2010 through achievement of the sub-targets (Canadian Council of Motor Transport Administrators 2016). While the 30% reduction in fatalities and serious injuries was not met by 2010, it was achieved in 2011 (Canadian Council of Motor Transport Administrators 2016).

In 2011, *Road Safety Strategy (RSS) 2015* was introduced. *RSS 2015* moved away from numerical targets, approaching road safety in a new, holistic way, and introducing the safer systems concept to tackle road user, vehicle, and road infrastructure issues (Canadian Council of Motor Transport Administrators 2016). This strategy introduced a framework of best practices, consisting of a multicell matrix of key risk groups and contributing factors, and an inventory of road safety initiatives that could be adopted to address priorities (Canadian Council of Motor Transport Administrators 2016). Jurisdictions were encouraged to develop their own road safety plans to meet their individual needs and adopt interventions to reduce fatalities and serious injuries (Canadian Council of Motor Transport Administrators 2016). In 2013, the number of fatalities and serious injuries on Canada's roads decreased by 21% compared to the 2006–2010 period (Canadian Council of Motor Transport Administrators 2016).

Finally, *Road Safety Strategy (RSS) 2025* is focused on the ambitious vision of "Toward Zero," and is based on the Vision Zero approach in Sweden and adopting the Safe Systems Approach to road safety (Canadian Council of Motor Transport Administrators 2016). Canada's Vision Zero approach can be characterized by the focus on helping and encouraging individual jurisdictions to implement road safety programs that meet their own needs, focused on the Safe Systems Approach and with an aspiration to achieve downward trends in fatalities and serious injuries on Canada's roads (Canadian Council of Motor Transport Administrators 2016).

## Overview of Vision Zero in Canada

Vision Zero efforts in Canada began in a number of places including Edmonton, Alberta in 2015, and have continued to spread across the country since. Vision Zero has been adopted at the local or municipal level, such as in the City of Toronto, Ontario in 2016, to the provincial level, such as across the Province of British Columbia in 2016, and finally, at the national level, with the Road Safety Strategy 2025 also being developed in 2016. Several cities and regions, both rural and urban, continue to adopt Vision Zero in their jurisdictions.

Each level of government in Canada maintains unique road safety responsibilities; thus, when implementing Vision Zero in Canada, it is important to understand the governmental jurisdictional responsibilities and address each one, taking a collaborative approach to Vision Zero and road safety as a whole. This collaboration is exemplified through Canada's national road safety approach, which formally adopts

Vision Zero in principle. The Canadian Council of Motor Transport Administrators (CCMTA) developed Canada's Road Safety Strategy 2025 in 2016. The CCMTA is composed of representatives from all levels of the Canadian government, from the smaller-scale municipal level to the provincial, and finally the federal level. Each level contributes to the development of different road safety countermeasures.

To provide an example, standards for vehicle manufacturing are solely a federal responsibility, whereas built roadway design, maintenance, and re-design are shared among provincial or territorial, municipal, and First Nations governments. Further, while traffic laws are developed by federal, provincial/territorial, and municipal governments, they can be enforced by police at any level, such as the Ontario Provincial Police (OPP) at the provincial level, First Nations police, and the Royal Canadian Mounted Police (RCMP) at the national level (Government of Ontario 2019). Each level of government has a role to play in road safety in Canada and in the adoption of Vision Zero.

## Vision Zero National/Federal

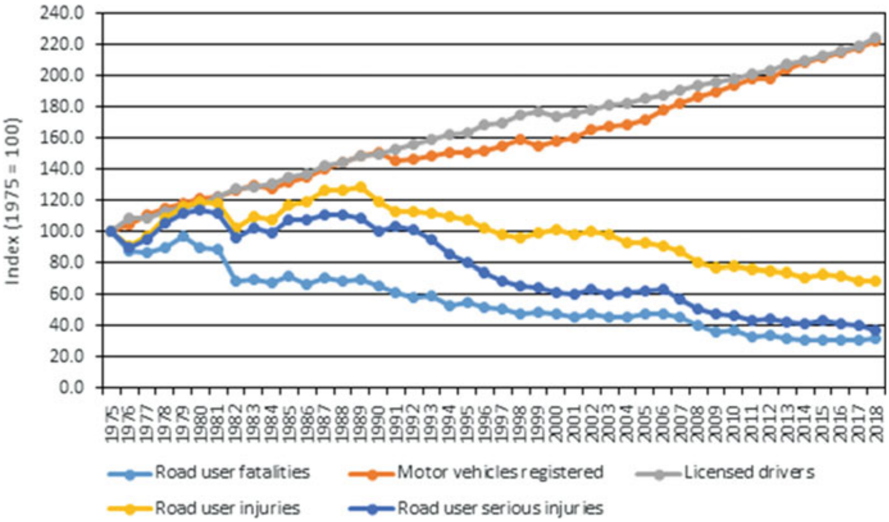
### Transport Canada

Transport Canada is committed to keeping Canadian road users safe. As a federal regulator, the department updates vehicle safety regulations, standards and requirements for passenger vehicles, commercial vehicles, tires, and child car seats in Canada. The department plays an active role in crash test research and conducts tests on vehicle control technology and safety systems. Transport Canada is a leader in vehicle-defect reporting and investigations, and maintains the motor vehicle safety recalls database – the largest of its kind in Canada. The department also fosters innovation through its support, testing, and funding of projects related to automated vehicles, connected vehicles, and vehicle cybersecurity.

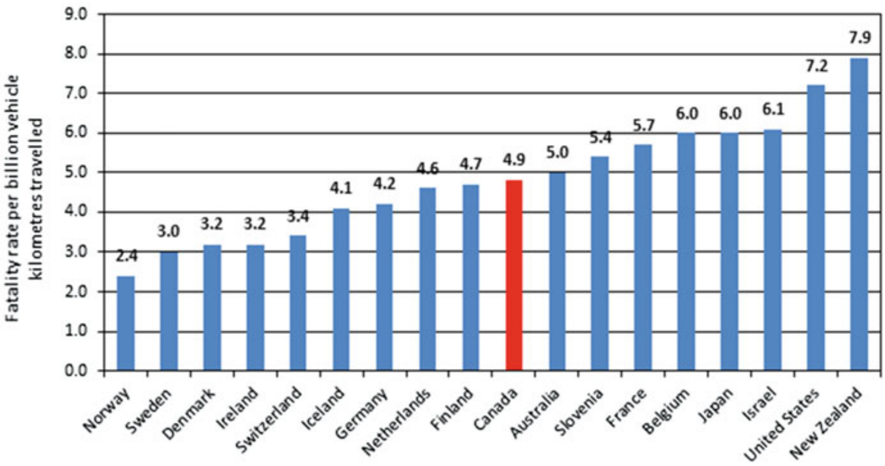
To advance a cohesive, national approach to road safety, Transport Canada works closely with the provinces and territories through the CCMTA on a range of national road safety issues, including commercial motor vehicle safety and vulnerable road users safety. Similarly, Transport Canada also works closely with the Transportation Association of Canada (TAC) to advance collaboration on safe road and highway infrastructure.

#### Overall Level of Road Safety

Over the last several decades, there has been a significant downward trend in motor vehicle casualties. Fatalities have decreased by almost 68%, while serious injuries have declined by 62% (Transport Canada, National Collision Database 2017). This notable progress was achieved despite significant growth in Canada's population, number of licensed drivers (+122%), number of registered vehicles (+124%), and vehicle kilometers travelled (Transport Canada as compiled from information provided by provinces and territories; Statistics Canada 2020).




In 2017, Canada was ranked 10th in terms of fatalities per billion vehicle kilometers travelled compared to other member countries of the Organization for Economic Cooperation and Development (OECD) (OECD International Transport Forum 2019). Safer vehicles, road infrastructure, and road user behavior have contributed to this greater level of safety. Seat belt use, for example, has increased from about 20% in the 1970s to 97% in 2016–2017.




Despite this tremendous progress, there is still significant work to be done. Transport Canada is a strong supporter of the international Vision Zero initiative to advance road safety. Our work in support of Vision Zero is facilitated through Canada's own Road Safety Strategy 2025. The Strategy has been endorsed by all ministers responsible for transportation and highway safety at the federal and provincial/territorial levels. An overview of key road safety issues and priority areas of Transport Canada's work in support of this strategy are discussed in further detail below.

### Impaired Driving

Transport Canada continues to work collaboratively with provinces and territories through the CCMTA to address impaired driving. This includes assisting the provinces and territories in conducting roadside surveys to assess the number of drug-impaired drivers on the road. Through collaboration with the provinces and territories and partners from the road safety community, the percentage of fatalities involving a driver considered by police to be under the influence of alcohol has decreased from 21% in 2008 to 14% in 2017 (Transport Canada, National Collision Database 2017). Data also indicates that the percentage of Canadians that were fatally injured in road crashes involving a drinking driver has decreased from 34% in 2008 to 29% in 2016 (Lyon et al. 2019).

Further progress to address impaired driving will be supported by 2018 amendments to the Criminal Code of Canada (CCC). These amendments included new offenses related to driving under the influence of cannabis as well as new authorities for police to demand that any lawfully stopped driver provide a breath sample to test for alcohol.

### Distracted Driving

Distracted driving is a serious safety concern for all Canadians. To address this challenge, all levels of government are working together through the CCMTA to implement an action plan on distracted driving. Key initiatives include: creating nationally consistent penalty regimes; supporting the development and refinement of data sources; and developing a best practice model for addressing distracted driving, including legislative measures, enforcement tools, and techniques to assist police.

As part of this action plan, the department worked closely with the CCMTA and the provinces and territories to develop a report on distracted driving, which includes best practices for addressing this issue. Published in December 2018, the report is available at https://ccmta.ca/en/ccmta-s-distracted-driving-white-paper-now-available.

Transport Canada also encourages vehicle and electronics manufacturers to design devices that are compatible with safe driving. In February 2019, the department published the Guidelines to Limit Distractions from Visual Displays in Vehicles, which can be found at http://www.tc.gc.ca/en/services/road/stay-safe-when-driving/guidelines-limit-distraction-visual-displays-vehicles.html.

### Vulnerable Road Users (VRUs)

Transport Canada is taking action to better protect vulnerable road users, including pedestrians and cyclists. In October 2018, the Council of Ministers Responsible for Transportation and Highway Safety published its report Safety Measures for Cyclists and Pedestrians around Heavy Vehicles – Summary Report outlining 57 safety measures to better protect vulnerable road users. Further, in January 2019, the Council of Ministers approved next steps for the implementation of the report, with an emphasis on pilot projects, knowledge exchange, and reviewing safety standards and regulations. To build momentum in this area, Transport Canada has launched on-road field trials, in collaboration with municipal partners, to evaluate the effectiveness of a detection and visibility system on commercial vehicles.

### Heavy Commercial Vehicles

Commercial motor vehicle safety is also a shared responsibility among federal, provincial and territorial governments, and owners/operators. Under the Motor Vehicle Safety Act, Transport Canada is responsible for establishing the Canada Motor Vehicle Safety Standards, which includes specific safety requirements for commercial motor vehicles, such as brake systems, stability control, tires, and lighting, among others. The Department works with all levels of government to keep these standards up-to-date, and performs tests to ensure compliance. Under the Motor Vehicle Transport Act, Transport Canada is also responsible for certain operational matters relating to commercial motor vehicle activity (e.g., hours of service and safety ratings).

Our collaborative work with provinces and territories through the CCMTA to strengthen commercial motor vehicle safety includes measures to prevent fatigue and distracted driving. For example, in June 2019, the department published a regulation mandating electronic logging devices (ELDs) for commercial carriers to reduce the risk of fatigue-related collisions. The work with the CCMTA also includes finalizing a national standard for entry-level training for commercial drivers. This standard represents an important milestone for road safety in Canada and will help ensure drivers have the necessary knowledge and skills to safely operate commercial vehicles.

While school buses are recognized as the safest way to transport school children in Canada, Transport Canada, together with provincial and territorial partners, recognizes that there are ways to make school buses even safer. To advance this important issue, on January 21, 2019, the federal, provincial, and territorial Council of Ministers Responsible for Transportation and Highway Safety established an expert Task Force on School Bus Safety, composed of the aforementioned governments, fleet operators, bus manufacturers, school boards, driver unions, and safety associations, to identify opportunities to further strengthen school bus safety. Specifically, the Task Force was mandated to review safety standards and operations, both inside and outside the school bus, with an emphasis on seat belts.

### Automated and Connected Vehicles

Transport Canada has undertaken a number of initiatives to support the safe testing and deployment of connected and automated vehicle technologies, building on recommendations found in the January 2018 report Driving Change, prepared by the Senate Committee on Transport and Communications. Since the report's publication, Transport Canada has amended the Motor Vehicle Safety Act (MVSA - March 2018) to afford greater flexibility to keep pace with emerging technologies (e.g., modernized/new authorities to grant exemptions, take enforcement action, and modify or suspend outdated regulations).

In February 2019, the department also released Canada's Safety Framework for Automated and Connected Vehicles, which articulates the department's vision for the safety of these technologies. The Framework is supported by a number of guidance documents including the Safety Assessment for Automated Driving Systems in Canada, and Testing Highly Automated Vehicles in Canada: Guidelines for Trial Organizations. All of these documents as well as additional information on the Government of Canada's work to address automated driving systems can be found at: http://www.canada.ca/automatedvehicles.

Transport Canada is also conducting research into advanced driver assistance systems, which in many cases feature low-level automation features that can enhance the safety of road users. Transport Canada continues to explore ways to support consumer awareness of the safe use of these features, including publishing information at: https://www.tc.gc.ca/en/services/road.html.

## Canadian Council of Motor Transport Administrators Road Safety Strategy 2025

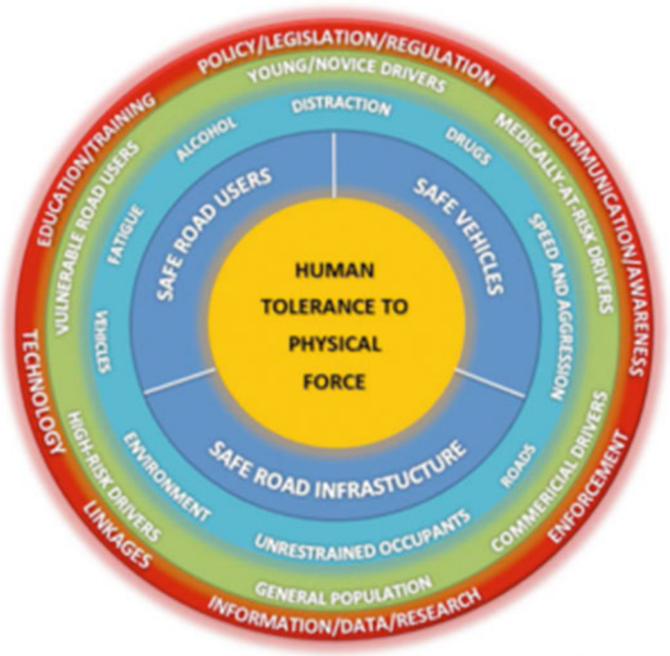
The Canadian Council of Motor Transport Administrators (CCMTA) coordinates matters dealing with the administration, regulation and control of motor vehicle transportation, and highway safety. CCMTA members represent provincial, territorial, and federal governments and are committed to shared road safety goals in Canada. CCMTA works for Canadians by ensuring that government and road safety stakeholders have a national forum to come together and share knowledge on current and emerging road safety priorities that impact jurisdictional and national policy. This approach is built on the values of engagement and accountability, and respects jurisdictional autonomy to adopt or adapt specific programs as appropriate. Canada is one of the first countries in the world to adopt a national road safety strategy in 1996 and, to date, three national strategies have been launched (2001, 2010, and 2015). With the help of CCMTA's road safety programs, research, collaborative partnerships, and public education campaigns, Canada has seen continued downward trends in fatalities and serious injuries on roads despite more drivers, vehicles, and kilometers travelled since 2001(CCMTA 2016).

Road Safety Strategy 2025 is intended to continue to encourage road safety stakeholders from all levels of the government, as well as private sector, and non-governmental stakeholders, to collaborate in making Canada's roads the safest in the world and unite efforts to reach the long-term vision of zero fatalities and serious injuries on Canadian roads. It was developed with the intention of helping jurisdictions implement road safety programs that meet their own needs. Road Safety Strategy (RSS) 2025 is similar to its predecessors in a number of ways. It retains the long-term vision of making Canada's roads the safest in the world but combines this with the vision of **Toward Zero**. A number of principles key to the strategy's success have been aligned with international best practices in road safety. These principles include adopting the Safe System Approach, a 10-year timeline, and providing an inventory of proven and promising best practices to address key risk groups and contributing factors.

**RSS 2025s vision, "Toward Zero – The safest roads in the world"** is based on an international best practice first adopted by Sweden in 1997, where Vision Zero was approved by parliament and has permeated the country's approach to road safety ever since. It has resulted in Sweden having among the lowest traffic-related fatality rates worldwide and has led to other countries and municipal governments initiating similar approaches. Toward Zero is not a target to be achieved by a certain date; it is aspirational. This vision will continue beyond RSS 2025s timeline and highlights the desire for the best road safety outcomes for all Canadian jurisdictions.

The following strategic objectives form the cornerstone of RSS 2025 and focus on safer road users, road infrastructure, and vehicles: raising public awareness and commitment to road safety; improving communication, cooperation, and collaboration among stakeholders; enhancing legislation and enforcement; improving road safety information in support of research and evaluation; improving the safety of vehicles and road infrastructure; and leveraging technology and innovation. Core to the strategy is an inventory of best-practice interventions used by leading road safety countries that have been effective in reducing fatalities and serious injuries.

RSS 2025 further lays out guiding principles to adopt a Safe System Approach. The Safe System Approach (SSA) is how many countries leading in road safety are achieving their vision of eliminating deaths and serious injuries. SSA contains the following principles: Ethics (human life and health are paramount and take priority over mobility and other objectives of the road traffic system and life and health can never be exchanged for other benefits within the society); Responsibility (providers and regulators of the road traffic system share responsibility with users); Safety (road traffic systems should take account of human fallibility and minimize both the opportunities for errors and the harm done when they occur); and mechanisms for change (providers and regulators must do their utmost to guarantee the safety of all citizens; they must cooperate with road users; and all three must be ready to change to achieve safety). It is recognized that Canadian jurisdictions will implement the SSA in a manner that is appropriate to their environments.




*Source of picture: CCMTA version specifically developed for RSS 2025 adapted from the 2009 WHO report on the Global Status on Road Safety which was in turn modified from work commissioned by the Government of Western Australia.*

RSS 2025 seeks to achieve directional downward trends in the rate-based number of fatalities and serious injuries rather than in the actual numbers of fatalities and serious injuries. These trends will be measured at the national level annually, using multi-year rolling averages to smooth out short-term fluctuations since year-over-year reductions may not be practical or attainable. In Canada, the rate-based indicators are fatalities and serious injuries per billion kilometers traveled and fatalities and serious injuries per one hundred thousand population. These rate-based indicators are commonly used internationally as well. Although RSS 2025 does not include hard quantitative targets, it does not preclude individual jurisdictions or organizations from establishing their own targets when there is government, law enforcement, and/or road safety stakeholder support for doing so.

## Canadian Association of Road Safety Professionals: A Multidisciplinary Approach to Vision Zero

The Canadian Association of Road Safety Professionals (CARSP; CARSP.ca), founded in 1985, is a national organization dedicated to enhancing road safety at home and abroad. CARSP currently has a membership of 551 members (both individual and corporate). CARSP supports Canada's road safety community by providing access to multi-disciplinary information, research, and networking opportunities. CARSP is a diverse group of professionals involved in the research, management, delivery, and promotion of road safety programs, from a broad array of disciplines (from engineering to social science and health promotion) and employers (public, private, at the federal, provincial, and local levels). CARSP encourages the sharing of professional experience; facilitates communication and cooperation among road safety groups and agencies; promotes research and professional development; and provides an influential voice for road safety professionals to communicate knowledge-based advice to policymakers.

CARSP members belong to various disciplines: Government (Federal, provincial/territorial, or local); Police/enforcement (federal, provincial/territorial, and local); University/College (e.g., Engineering, Psychology, Epidemiology, and Health Sciences); nonprofit safety organizations (e.g., Safety Councils, Injury Prevention units, and Drinking and Driving Counterattack groups); private consultants (e.g., in Engineering, Planning, Geography, and Technology); research agencies (e.g., Traffic Injury Research Foundation, Canadian Centre on Substance Abuse), driving institutes, motor associations (e.g., Canadian Automobile Association), insurance organizations (e.g., Saskatchewan Government Insurance, Insurance Corporation of British Columbia, and Manitoba Public Insurance); and legal professionals.

CARSP's vision statement is: "Professionals collaborating in research and practice to make our roads the safest in the world." Vision Zero and other related statements with an ultimate goal of zero fatalities and serious injuries on public roads are consistent with CARSP's vision. CARSP's position is that statements of Vision Zero, while important, are unlikely to accelerate progress toward such a goal without quality data, rigorous evaluation, bold leadership, sustainable funding, and significant changes in both the public and institutional culture. The expansion of dedicated facilities for vulnerable road users, the continuing shift from personal vehicle to public transit use, significant changes to land use planning and speed management and the evolution of vehicle automation are all critical toward achieving these goals.

To help spread knowledge about Vision Zero in Canada, CARSP has given it a strong emphasis in the planning of its activities. CARSP hosts an annual conference that attracts Canadian and international delegates. The conference features keynote speakers, panel discussions and paper sessions in both "Policy and Practice" and "Research and Evaluation" streams. Vision Zero topics have been included since 2015 and were the overall conference theme in 2019.

The 2019 conference included sessions on the Safe Systems Approach and city-wide road safety plans, distracted driving and crossing, vulnerable road user safety, speeding and risky driving, cycling safety, driver training and driver fitness, truck safety, pedestrian safety, autonomous vehicles, connected vehicles and networks, and advanced vehicle technology and built environment's relationship to road safety, to name a few. A special "fireside chat" panel session on Vision Zero was also held, in which themes such as the public health approach and the power of the media and the general public in Vision Zero were explored. A full-day workshop, "Vision Zero – Understanding and Action," was also held as part of the conference, which translated the principles of Vision Zero into decision and action using real-life examples.

CARSP regularly offers in-person workshops and webinar presentations on Vision Zero, delivered by a wide range of practitioners from across Canada and abroad. Its monthly publication, *Canadian Road Safety News Digest,* covers the latest news stories across the country related to Vision Zero; and a quarterly newsletter, *The Safety Network*, covers initiatives and research by road safety professionals on topics such as Vision Zero. Finally, in support of its vision to make Canadian roads the safest in the world, CARSP continues to coordinate with other national organizations – such as Parachute and the Transportation Association of Canada – to collaborate on areas of common interest related to Vision Zero. CARSP maintains the clear and persuasive position that only through a complete multi-disciplinary approach endorsed by organizations such as CARSP can the ultimate goal of zero be achieved.

## Transportation Association of Canada: Road Safety and Vision Zero

The Transportation Association of Canada (TAC; www.tac-atc.ca) is a not-for-profit, national technical association that focuses on road and highway infrastructure and urban transportation. Its 500 corporate members include governments, businesses, academic institutions, and other associations. TAC provides a neutral, nonpartisan forum for those organizations, and their thousands of staff, to come together to share ideas and information, build knowledge and pool resources in addressing transportation issues and challenges.

TAC celebrated its centennial in 2014 and, with more than 100 years of history in the transportation sector, is continuing its important work to identify best practices and encourage harmonization of those practices across jurisdictions. While TAC does not set standards, it produces credible transportation planning, design, construction, management, operation, and maintenance guidelines that emphasize safety. Safety is one of six focus areas in TAC's strategic plan, which encourages efforts to address road safety through a combination of engineering, education, and enforcement, and by adopting Safe Systems Approaches to plan, design, and build infrastructure, and deliver transportation services. To that end, almost every TAC technical guideline offers means, directly or indirectly, to improve and ensure transportation safety.

TAC's volunteer councils and committees share knowledge, exchange information, and discuss a wide variety of issues to advance the state of transportation. The Road Safety Standing Committee (RSSC), formed in 2000, is concerned with raising awareness of road safety issues among TAC members; identifying and prioritizing road safety issues; promoting safety-conscious, knowledge-based approaches; emphasizing the need for dedicated roadway safety staff at all levels of government; and providing road safety training for transportation professionals.

For several years, the RSSC has endorsed the Safe Systems Approach, with engineering as a critical component. Since 2015, the RSSC has discussed Vision Zero and organized several conference sessions, workshops, and webinars related to the development of road safety plans. In its newly adopted strategic plan, the RSSC commits to be a catalyst for Vision Zero and Safe Systems Approaches. This direction is supported by three initiatives: (1) Create a Vision Zero and Safe Systems Subcommittee; (2) Conduct a constructive review of TAC publications with respect to safe systems concepts; and (3) Enable Vision Zero and safe systems knowledge exchange.

TAC has spent several years developing a series of publications on road safety for Canadian practitioners and is now planning future enhancements to consolidate this knowledge into a comprehensive guide. Finally, road safety will also be the theme of TAC's 2020 Conference and Exhibition in Vancouver, British Columbia. Through these and other endeavors, TAC and its RSSC will continue to support research and development, knowledge transfer, and the development of guidelines in support of Vision Zero and Safe Systems principles.

## Traffic Injury Research Foundation: Strategies to Support Vision Zero in Canada

The Traffic Injury Research Foundation (TIRF; www.tirf.ca) is one of Canada's road safety research institutes and a world leader in research, program and policy development, evaluation, and knowledge transfer. Established as a registered charity, TIRF studies the human causes and effects of road crashes. Its focus is on people on the roads and behaviors that result in driver error and account for more than 90% of road crashes.

For more than four decades, TIRF has maintained a National Fatality Database to enhance understanding about why road users behave as they do. These data have been the foundation for the development and implementation of solutions aimed at addressing underlying causal factors. TIRF's work has evaluated a broad spectrum of road safety policies and programs and helped stakeholders identify effective solutions. Its research has been widely shared to inform decisions and action by government, business and industry, traffic safety agencies, and nonprofit organizations in many countries. Findings published by TIRF have contributed to crash reductions and improved safety for all Canadians by creating and sharing knowledge about current and emerging issues and trends that place road users at risk.

Most importantly, TIRF has developed its own knowledge transfer model using a "Systems Approach" to promote shared understanding of issues with a focus on implementation. This has enabled TIRF to bridge gaps and build partnerships among agencies and practitioners across the many sectors affected by road crashes. Collectively, these activities are important to help support Vision Zero initiatives at all levels in Canada. As jurisdictions increasingly adopt strategies to achieve zero deaths, research and best practices are essential to guide the development of programs and policies, just as evaluation research is vital to determine if investments in countermeasures are wise and will produce a return on investment in the form of fewer deaths and injuries. Of equal importance, communities need tools to help them use research as they embark on the pursuit of road safety strategies. Today, many communities are better informed about what needs to be done to make roads safer, but they struggle with how to do it.

To fill this gap, in 2017 TIRF turned its attention to creating knowledge and a series of tools to help communities do just that. TIRF, in partnership with Desjardins, used its knowledge and expertise gained over five decades to design a web-based suite of road safety resources, the Action2Zero Centre. The objective of this Center was to help communities use research to guide the development and implementation of strategic road safety plans based on Vision Zero and Safe System philosophies. In particular, the Center can enable communities to raise awareness and build capacity for effective road safety initiatives, to monitor and measure program outcomes and improvements in road safety, and to support the work of local governments and their road safety partners.

A key feature of the Center is an automated, online tool that communities can use to assess the status of road safety in their community across several domains, such as speed management, infrastructure for vulnerable road users, distracted driving, and leadership. The assessment tool developed by TIRF uses a set of road safety criteria for a five-star community based on international research and best practices. This five-star community approach is in line with other areas of safety that describe five-star ratings for roads (e.g., International Road Assessment Program or IRAP) and vehicles (e.g., five-star safety ratings for vehicles used by the National Highway Traffic Safety Administration or NHTSA, and the Insurance Institute for Highway Safety or IIHS). As such, the assessment tool helps communities track progress toward five-star status.

The Center meets the needs of a wide spectrum of road safety stakeholders including local government, public health, law enforcement, schools, community-based organizations, engineers, and city planners. The online tool enables communities to identify which measures have been implemented and areas where greater efforts are required. Ultimately, outcomes of the tool provide a clear picture of potential components of a strategic plan and suggest the types of knowledge, expertise, and resources needed to achieve further reductions in road deaths and injuries.

It is structured in several stepwise modules to help communities build support, buy-in, and partnerships for the implementation of plans to accelerate action and improve road safety outcomes. A suite of templates and tools, links to relevant research, and best practices are contained within the Center to share experiences from other jurisdictions and help communities implement a variety of road safety strategies, such as creating effective road safety campaigns, improving safety in school zones and reducing speeds in residential areas. It also provides guidance on approaches to engaging stakeholders, building partnerships and communities of practice, and organizing committees for specific tasks. This initiative is being piloted in three jurisdictions in Canada and will launch in 2019 at act2zero.tirf.ca.

## Parachute: Vision Zero Network

Parachute is Canada's leading national charity dedicated to injury prevention, with a vision of a Canada free of serious injuries, with Canadians living long lives to the fullest. Parachute Vision Zero works to share current research and best practices in road safety, support data-driven models, create and disseminate evidence-based resources, and bridge key multisector players together to increase the overall awareness and effectiveness of the Vision Zero approach. By building awareness of Vision Zero, Parachute also builds capacity for more jurisdictions across Canada to integrate a Vision Zero approach. At an individual level, implementing the Vision Zero approach in communities will ultimately lead to a shift in thinking about motor vehicle collisions, moving away from the belief that these are *accidents* and toward the understanding that collisions are predictable and preventable.

Parachute Vision Zero provides case studies and infographics on important road safety topics, such as safe school zones, cannabis- and drug-impaired driving, collision avoidance systems in vehicles, and data-driven approaches, alongside summaries of Vision Zero implementation experiences across Canada, including videos and interviews with key stakeholders. Further, Parachute Vision Zero gathers Vision Zero resources worldwide and has also created several of its own resources and tools to help communities move from thinking about Vision Zero to adopting and implementing this road safety approach successfully.

Parachute, with support from Desjardins, created the Parachute Vision Zero Network to bring together road safety experts and advocates across Canada. Parachute acts as a facilitator to create positive change by bringing network members together to exchange information and ideas, and to work together to improve safety on Canada's roads. The Network continues to grow, with more than 335 members as of October 2019.

Parachute has remained active as a leader in Vision Zero in Canada, participating in panel discussions, holding events such as summits for Parachute Vision Zero Network members, and speaking at major conferences, such as the CARSP conference in Calgary, Alberta in May 2019. In 2017, Parachute held a two-day conference for Vision Zero Network members, bringing together grassroots organizations, enforcement, public health professionals, and researchers to discuss the implementation of Vision Zero in Canada. In 2019, Parachute's President and CEO, was a keynote speaker at the CARSP Conference, delivering a presentation on Vision Zero in Canada. Parachute was also active in panel discussions and a post-conference workshop at the CARSP conference.

Health Canada Substance Use and Addictions Program (SUAP) provided funding to Parachute for a three-year project entitled *#KnowWhatImpairedMeans*. The project looks at drug-impaired driving in Canada, particularly among Canadians between 15 and 24 years of age. As cannabis became a legal drug in Canada in 2018, Parachute launched a small-scale #KnowWhatImpairedMeans campaign to point out that, while cannabis was now legal, it is still illegal to drive high and can have a negative effect on a person's reaction time and focus. The national #KnowWhatImpairedMeans campaign launched in fall 2019 and was designed to raise awareness around the dangers of drug-impaired driving, in a way that resonates with online youth audiences. Messaging is informed by the population of interest, is evidence-based, and focuses on why cannabis impairs one's ability to operate a motor vehicle safely. Learn more about the #KnowWhatImpairedMeans campaign at parachute.ca/knowwhatimpairedmeans.

## Canadian Research Related to Vision Zero

There is a significant volume of road safety research taking place in provinces across Canada. These research studies cover a number of key topic areas, including: active transportation and safe school zones, impaired driving, road safety countermeasures (technology and infrastructure), and vulnerable road users (cyclists, pedestrians, and older adults), to name just a few.

### Active Transportation and Safe School Zones

Active transportation refers to any human-powered form of travel, such as cycling, walking, and skateboarding. Often, research may look at active transportation and safe school zones in combination, given the overlap in the subject areas and the need for children to be able to travel to and from school safely, regardless of their mode of transportation. Safe school zones often include measures such as traffic calming, built environment changes, and enforcement. Some Canadian research studies in these areas include:

- *Alberta*
  - *Child Active-transportation Safety and the Environment* (CHASE), Hagel et al.
  - *Before and After Evaluation of School Zones*, El-Basyouny.
- *Ontario*
  - *Effectiveness of Built Environment Interventions Around Schools in Improving Road Safety and Increasing Active School Transportation*, Rothman et al.
- *Quebec*
  - *Children and social interaction outside school: what are the roles of transport and information and communication technologies (ICTs)?*, Owen Waygood.

### Impaired Driving

With the legalization of cannabis in Canada and continuous monitoring of drinking and driving regulations, there is a need for research on different influences, environments, and interventions around impaired driving. Impaired driving research studies in Canada are looking at the effects of driving under the influence of drugs (including cannabis), alcohol, and prescription medications. Canadian research in this area includes:

- *British Columbia*
  - *Monitoring and Preventing Drug-Impaired Driving in Canada*, Brubacher et al.
  - *Prescription Medications and the Risk of Motor Vehicle Crashes,* Brubacher et al.
  - *Evaluation of the Effect of Cannabis Legalization on Road Safet*y, Brubacher et al.
  - *Cannabis and Motor Vehicle Crashes: A Multicentre Culpability Study,* Brubacher et al.
- *Quebec*
  - *Team in Transdisciplinary Studies on Driving While Intoxicated at the Douglas Research Centre, McGill University,* Marie Claude Ouimet and Thomas Brown.

### Road Safety Countermeasures

Road safety countermeasures are steps that are taken to improve road safety for all road users. Road safety countermeasures can include technology advancements, such as driver feedback signs, photo enforcement, and red light cameras, built environment changes such as roundabouts, cycling lanes, and intersection improvements, or policy changes such as speed limit reductions. Some Canadian research in this area includes:

- *Alberta*
  - *A Safety Assessment of Driver Feedback Signs* (DFS) *and Development of Future Expansion Program*, El-Basyouny and Kwon.

  - *Deployment Strategies for the City of Edmonton's Mobile Photo Enforcement* (MPE) *Program,* El-Basyouny and Kim.
  - *Before and After Evaluation of Intersection Safety Devices* (ISD) *Evaluation,* El-Basyouny.
- *British Columbia*
  - *Evaluation of Traffic Safety Interventions in British Columbia, Brubacher et al.*
  - *Evaluation of Speed Limit Changes in British Columbia, Brubacher et al.*

## Vulnerable Road Users (VRU)

Vulnerable road users (VRU) are unprotected against the speed and mass of vehicles on our roadways and thus tend to suffer more severe consequences in collisions (European Road Safety Observatory 2018). Studies in this area cover VRUs such as cyclists, pedestrians, and older drivers, considering factors such as the influence of the built environment on VRU crashes. Canadian research in this area includes:

- *British Columbia*
  - *Bicyclists' Injuries and the Cycling Environment (BICE) study*, Teschke et al.
- *Quebec*
  - *CHASE project: Child Active Transportation Safety and the Environment, Marie-Soleil Cloutier.*
  - *Pilot project on the road safety of all-way stops intersections using surrogate safety methods, Luis Miranda-Moreno.*

Another major trend in research on driving behavior and mobility is related to the growing older adult population. Older adults often require monitoring of their driving through education, evaluation, and intervention, and help to cope with the eventual end of their driving "career" in certain cases. Canadian research in this area includes:

- *Quebec*
  - *Impact of two functional capacity training programs on the ability to drive of older drivers*, Martin Lavallière.
  - *To drive or not to drive? Understanding the influence of the complex relationships between personal and environmental factors on the driving mobility of older Canadians,* Mélanie Levasseur.

This is not a comprehensive list of research being conducted in Canada related to Vision Zero. Dr. Karim El-Basyouny's study, *Assessing the Safety Effects of Achieving Bare-Pavement Road Conditions for Winter Maintenance* and Dr. Jeff Brubacher's study, *Predictors of Poor Health and Functional Recovery Following Road Trauma: An Emergency Department Inception Cohort Study.*

## Vision Zero Implementation

### British Columbia

#### Background

British Columbia (B.C.) is home to more than five million residents, ranking as the third-highest populated province in Canada (Government of British Columbia 2019; Statistics Canada 2019). With a long history of natural resource use, B.C. hosts a large, unpaved road network – covering 66% of the entire province's land base. There are precisely 57,100 km of paved roads in comparison to the massive 662,000 km of unpaved roads (Environmental Reporting BC 2018). Although there is a smaller paved road network compared to land mass, safe roadways and systems are critical to the residents, businesses, and visitors who travel the vast province using multiple modes of transportation each day. On average, B.C. receives nearly 20 million visitors each year, with more than seven million visitors using key highways throughout the province (Destination British Columbia 2019).

The province has a diverse and lush natural landscape, with rapidly changing weather and climate conditions, which can create a unique challenge when analyzing roadways and infrastructure. In addition, B.C. is located along Canada's Pacific Gateway, moving people and goods between North America and the world through marine ports, railways, roads, and airports to provide efficient and reliable market access.

In Vancouver, the province's largest city, there is a higher percentage of residents walking or cycling to work than any other major city in Canada (City of Vancouver 2017). Fifty-two percent of residents drive, 16% travel by transit, 25% walk, and 7% cycle (City of Vancouver 2017). Fifty-five percent of fatal collisions on Vancouver roads in 2017 involved pedestrians, cyclists, or skateboarders (City of Vancouver 2019). In Surrey, a major city in British Columbia, 81% of residents drive, 15% travel by transit, 3% walk, 1% travel via motorcycle, and 0.4% cycle (City of Surrey n.d.). In Vancouver, 55% of fatal collisions in 2017 involved pedestrians, cyclists, or skateboarders (City of Vancouver 2019). On Surrey roads, a pedestrian is 42 times more likely to die in a collision than a person driving a motor vehicle (City of Surrey n.d.).

#### Vision Zero in British Columbia

In 2016, B.C. became the first Canadian province to adopt Vision Zero. After success with *British Columbia Road Safety Strategy 2015*, the province released an updated report: *Moving to Vision Zero: Road Safety Strategy Update and Showcase of Innovation in British Columbia*, aligning with Canada's Road Safety Strategy and officially adopting Vision Zero (RoadSafetyBC 2016). B.C.'s approach to Vision Zero focuses on the four pillars of the Safe Systems Approach: safe road users, safe vehicles, safe roadways, and safe speeds, and incorporates evidence-based practices and in-depth study into how road safety is managed across the province.

B.C. uses 10-year collision data from police reports to monitor the effectiveness of their Vision Zero initiatives. The reports consider fatalities, serious injuries,

injuries, as well as the contributing factors for the collision(s) (RoadSafetyBC 2018). Factors include speeding, distracted driving, impairment and aggressive driving, driver error, and environmental factors. The most recent report (2008–2017) states speeding and impairment were the contributing factors that had the highest rate of fatal victims per police-reported crash. However, the most common factors for collisions can be attributed to distracted driving and aggressive driving.

## Countermeasures

### Collaborative Projects

The Ministry of Transportation and Infrastructure recently released its new active transportation strategy – *Move. Commute. Connect.* – designed to encourage active transportation use with a variety of incentives and work with communities to create policies and plans that support complete active transportation networks around the province (CleanBC 2019). This strategy includes a focus on safety and integrating transportation and infrastructure planning to ensure that projects such as new bridges and interchanges are designed to make walking, cycling, and transit safe and convenient for everyone. As part of this work, the Ministry released the B.C. Active Transportation Design Guide in June 2019, which is available free of charge to anyone in the world.

Further, led collaboratively by a Steering Committee of Senior Level Officials, and a cross-section of partners from across the Province, the B.C. Road Safety Strategy (BCRSS) aligns Vision Zero with the strategic direction for five working committees, each with a diverse group of experts in their fields, collaborating on road safety issues. The BCRSS Working Committees meet on a regular basis to identify issues and priorities, propose solutions, provide their diverse expertise and perspectives, and support the implementation of various initiatives.

Most recently, as part of the BCRSS, RoadSafetyBC released the B.C. Community Road Safety Toolkit to provide information for local governments on proven road safety best practices, including those that can improve safety for vulnerable road users, such as cyclists and pedestrians (Government of British Columbia n.d.-a). In addition to the development of the toolkit, the organization met with hundreds of local government representatives at their annual regional meetings, along with partners from the Insurance Corporation of British Columbia (ICBC), to talk directly to the communities about their unique road safety concerns.

The Ministry of Transportation and Infrastructure and the ICBC work on the Community Safety Enhancement Program and Road Safety Partnership, with the goal to address and improve local road safety priorities – based on community safety and requirements. The programs are driven by community input and could include roadside delineation, dedicated left-turn signals, improved pedestrian crosswalks, and additional traffic signals.

### Enforcement

B.C has advanced its enforcement techniques and tools over the past few years through several initiatives and projects. Some of the key areas are listed below, in addition to established and new programs, such as the Counterattack Drinking and Driving Campaigns, an Automated License Plate Program, and targeting prolific prohibited drivers.

The province has improved its legislation and policies to combat unsafe and high-risk driver behaviors. In 2010, B.C. introduced a comprehensive new law for distracted driving (electronic devices) and since that time the penalties associated with these offenses have been increased on two separate occasions. B.C. increased the fines and penalty points for anyone caught talking, texting, or emailing on a phone while driving. Using an electronic device while driving has now been classified as a high-risk offense, leading to mandatory driver improvement training. Currently, anyone with two distracted driving tickets in a three-year period will see their total financial penalties rise to as much as $2,000.

Additionally, the B.C. Government, police, and ICBC conduct two distracted driving education and enhanced enforcement campaigns each year, which also include advertising and social media support. Further, ICBC is also looking to use telematics to determine whether using this technology can improve road safety and driving behavior for inexperienced drivers.

Between 2012 and 2016, Intersection Safety Camera (ISC) sites in B.C. reported an average of 10,500 vehicles a year going at least 30 km/h over the posted speed limit, as detected by red-light cameras, which also monitor vehicle speeds. Speed has been one of the top contributing factors in casualty crashes at these intersections, which have had a combined total of more than 11,500 collisions per year. Speed cameras were activated in summer 2019 (Government of British Columbia n.d.-b). B.C. has recently activated new technology to ticket the registered owners of vehicles speeding through these intersections well over the posted limit on a red, yellow, or green light. New signs warn approaching drivers about the enhanced intersection speed enforcement.

Further, in summer 2019, the Ministry of Transportation and Infrastructure, in partnership with ICBC, applied High Friction Surface Treatment to 14 locations to reduce the frequency of rear-end collisions at key intersections and ramps. The treatments improve friction, allowing drivers to stop more quickly, reducing both the severity and number of collisions from occurring.

In 2018, B.C. with partner support from Mothers Against Drunk Driving (MADD) and Transport Canada, also conducted its eighth Roadside Survey. The survey measured the prevalence of alcohol and drug-affected driving, compared long-term trends, and established a baseline for measurement of the effects of cannabis legalization. More than 2,500 vehicles were randomly sampled from the traffic flow for participation in the survey (Beirness 2018). The number of vehicles that entered each of the survey sites ranged from 13 to 56 and depended on the volume and pattern of traffic, the time of night, day of the week, the number of refusals, the numbers of drivers who required transportation home, and the capacity of the survey crew to process drivers (Beirness 2018).

Finally, the province passed legislation in spring 2019, giving police new tools to remove drug-affected drivers from roads. The province introduced a new 90-day

Administrative Driving Prohibition (ADP) for drug-affected driving, and a zero-tolerance restriction for the presence of THC for new drivers in the Graduated Licencing Program (GLP). This proposed change mirrors what is now in place for the presence of alcohol for new drivers.

#### Adapting to the Environment

The goal of variable speed limits is to improve driver safety during adverse weather conditions and to reduce serious crashes in areas where weather patterns are prone to change quickly, which has the potential to make driving conditions more hazardous. The Ministry of Transportation and Infrastructure implemented variable speed signs on three corridors throughout the province as part of a pilot project to help reduce the frequency and severity of weather-related crashes. Ministry staff constantly monitor the system by analyzing the data and improving the algorithms to optimize recommended speed limits that best meet driver expectations and are in line with current conditions. The pilot resulted in 6.7% reduction in serious (fatal and injury) collisions. Flashing lights installed above each variable speed limit sign are activated when a reduced speed limit is in effect. Variable speed limit signs are regulatory; therefore, police have the authority to enforce the speed that is on the electronic sign.

Additionally, the Shift into Winter campaign includes more than 20 organizations working together to form the Winter Driving Safety Alliance. Shift into Winter is geared toward educating drivers and workers about the increased risk when winter weather makes roads more hazardous due to fog, rain, snow, and ice. The program includes an online resource kit for employers, trip planning, online courses, videos, presentations, and meeting guides. Further, each winter the Alliance combines digital highway displays, social media, and advertising to encourage all drivers to plan before traveling during the winter months.

#### Summary

The province's Vision Zero initiatives have been improving road safety through countermeasures, enforcement, public education and awareness, and through collaboration with partner organizations. In 2017, there were 276 fatal victims of motor vehicle crashes in B.C. While this number is still too high, this represents a decrease of approximately 22% since 2008. The Province has committed to tracking progress in absolute fatality numbers, as well as rate-based targets.

### Role of Partners

One of the main principles of Vision Zero is collaboration, and B.C. works with more than 150 representatives from nearly 60 road safety partner organizations – with the common goal of zero traffic fatalities and serious injuries. In 2012, B.C. created the BCRSS, a unique made-in-B.C. approach designed to leverage the efforts of the diverse network of B.C. road safety partners including government, the insurance sector, Crown entities, the health sector, law enforcement agencies, nonprofit organizations, road safety groups and partners, and academic researchers.

## Alberta

### City of Edmonton

#### Background

With a population of 972,223, Edmonton is the second-largest city in Alberta and the fifth largest in all of Canada (City of Edmonton 2019; World Population Review 2019). In response to more than 8,200 residents being injured and/or killed on the city's roads that year, Edmonton developed the first municipal Office of Traffic Safety in North America in 2006 (City of Edmonton n.d.-a; Parachute 2017). Since then, Edmonton has been taking major steps to improve road safety, resulting in a 59.8% decrease in the number of people injured from 2006 (8,221) to 2018 (3,307) (City of Edmonton n.d.-b).

#### Vision Zero Edmonton

City council approved *Edmonton's Road Safety Strategy 2016–2020* in September 2015 and, in doing so, made Edmonton the first Canadian city to adopt Vision Zero (City of Edmonton n.d.-c). Edmonton's Road Safety Strategy takes an evidence-based, Safe Systems Approach, and focuses on the five E's of Traffic Safety: Engineering, Enforcement, Evaluation, Education, and Engagement. Each of the five E's outlines strategies for improving road safety.

#### Countermeasures

##### Engineering

The city's goal for engineering is to design the transportation system in a way that anticipates human error, with an aim to prevent serious injuries and fatalities. Road safety audits and assessments, as well as network screening programs and an overall review of data, including collision data, provide the evidence needed to design and implement measures to make Edmonton's roads safer.

Engineering countermeasures include the increased use of prohibited and protected left-turn signals, improved right-turn designs, signalized right turns, upgraded pedestrian signals, improved crosswalk markings, increased use of amber flashers and rapid flashing beacons, implementation of pedestrian scrambles, use of driver feedback signs (speed display), and the use of retroreflective tape on signal heads and additional traffic signal fixtures to improve signal visibility. The strategy further outlines traffic calming strategies to reduce shortcutting, as well as the need for neighborhood speed reduction programs. Safe speeds are addressed through speed limits and speed management. Edmonton uses a continuum of speed management strategies, ranging from the placement of community signs with messaging such as "Give our kids a brake" and speed display signs, to enforcement.

##### Education

Edmonton's strategy recognizes the importance of education for increasing traffic safety. In 2014, Edmonton established a biennial Traffic Safety Culture Survey to better understand the behaviors and attitudes of road users (City of Edmonton 2015). The city uses these findings and additional research to inform new educational programs, create an annual traffic safety communications plan and to review existing programs. More than 5,000 residents participated in the 2018 survey (City of Edmonton n.d.-d).

Another unique method Edmonton is using to support education is the Vision Zero Street Team. This team was created in 2017 and brings traffic safety messaging to local events, traffic safety hotspots where new infrastructure has been installed and various locations across the city where there is an opportunity to interact with the public and share information about traffic safety. Most recently, the Vision Zero Street Team was out teaching drivers and pedestrians how to use "pedestrian scramble" style crosswalks. The strategy further encourages collaborative, educational traffic-safety projects with stakeholders to increase exposure and frequency of primary prevention initiatives.

#### Enforcement

Edmonton's strategy includes the use of enforcement to help reduce risky behaviors, placing an emphasis on speeding, impaired driving, and failure to wear seatbelts, as well as following-too-close, driving distracted, and identification of high-risk drivers. Edmonton employs a data-driven approach, which includes analyzing traffic hotspots to determine priority areas for enforcement. To minimize red-light running and speed-related collisions, Edmonton has installed Intersection Safety Devices that capture red light and speed violations, as well as automated mobile photo enforcement, with a focus on playground zones and high-collision locations. The Edmonton Police Service and the city work together on traffic-related initiatives and targeted enforcement.

#### Evaluation

Edmonton's strategy involves leveraging the work of the Edmonton Urban Traffic Safety Research Chair at the University of Alberta to evaluate ongoing transportation-related initiatives and develop new methodologies and best practices. The city also conducts research into automated enforcement for collision reduction and optimization of resource deployment. Other evaluation measures include advanced video-based road safety analytics to identify collision risk and the creation of road safety audit criteria.

#### Engagement

Public engagement is critical to the success of Vision Zero in Edmonton. Engagement activities are conducted to consult with the public about various traffic safety initiatives, such as changes to residential speed limits. Edmonton also engages citizens in other ways. For example, the Annual Run Walk Ride for Vision Zero is a family-friendly event that welcomes people affected by traffic crashes to honor the loved ones they have lost or who have been injured in a crash. There were 120 participants in 2018 (City of Edmonton n.d.-d).

Summary

Edmonton's Road Safety Strategy continues to improve traffic safety. A comparison of 2015 (pre-Vision Zero) to 2018 shows that pedestrian injuries have decreased by 21%, cyclist injuries by 29%, motorcyclist injuries by 26%, and injuries to vehicle occupants by 11% (City of Edmonton n.d.-c, n.d.-e). Overall, serious injuries have declined 17% while fatalities have dropped 41% (City of Edmonton n.d.-c). In 2018, compared to 2017, the Edmonton Police Service issued 2,319 fewer speeding tickets and overall speeds in Edmonton are decreasing (Edmonton Police Service, COGNOS Database 2019; City of Edmonton, Photo Enforcement Ticketing System 2019).

Some of the key successes during the first 3 years of Vision Zero in Edmonton include: the installation of 34 left-turn signal phase improvements; contributing to the redesign of 14 right-turn lanes; addition of 54 signal visibility improvements including retroreflective tape and new signal fixtures; installation of 48 pedestrian signals and/or amber flashers, plus 50 flashing beacons at schools (City of Edmonton n.d.-e); installation of 215 driver feedback signs, which have shown to reduce speeding by up to 12 km/h (City of Edmonton n.d.-d); upgrades to 64 school areas; and the implementation of 30 km/h playground zones, which have led to decreases in speed by 12 km/h (City of Edmonton n.d.-a). In addition, automated mobile photo enforcement has reduced fatal and injury collisions by 20% and speed-related collisions by 18%, while the installation of intersection safety devices have reduced angle collisions by 43% (City of Edmonton n.d.-a).

#### Role of Partners

The Edmonton experience has highlighted the significance of partnerships in the success of their Vision Zero approach. The city partners with numerous stakeholders, such as the Edmonton Police Service on targeted enforcement and collaborative media events, the University of Alberta and other academic institutions on research and evaluation, School Boards to understand, discuss, and work collaboratively to improve traffic safety around schools, and Community Leagues, community groups and organizations in relation to traffic calming and as part of neighborhood renewal, advocacy groups, businesses, and many others. As Edmonton moves toward the launch of the next iteration of its strategy in 2021, the Safe Mobility Strategy, there will be an increased focus on the lived experience of all road users and ensuring traffic safety for all.

### City of Calgary

#### Background

Calgary is the largest city in Alberta, with a population of 1,267,344 (City of Calgary 2018a). The city currently has 300 km of roadways, nine Light Rail Transit stations, and a 138 km Greenway, a pathway that connects 55 Calgary communities and connects to Calgary paths and trails, creating more than a 1,000 km network (City of Calgary 2016; Parks Foundation Calgary n.d.). The Greenway accommodates a 40% increase in cyclists in Calgary, resulting in more than 17,100 cycle trips every day

(City of Calgary n.d.-a). Downtown, the city also has the Plus 15 network, with 83 enclosed bridges connecting office towers to allow a safer way for pedestrians to travel (City of Calgary n.d.-b).

Despite the variety of options available for multimodal travel in the city, there were 517 major injury collisions and 11 fatal collisions on Calgary's roads in 2017 (City of Calgary 2018b). To take action against preventable tragedies, Calgary adopted Vision Zero and introduced its most recent *Safer Mobility Plan 2019–2023* in 2018.

### Vision Zero in Calgary

The City of Calgary's movement toward Vision Zero first began in the *Calgary Safer Mobility Plan 2013–2017*. This document is aligned with the Province of Alberta Traffic Safety Plan, Transport Canada's Road Safety Strategy, and the Global Decade of Action. The plan is based on a vision of safe mobility for all users and a mission to strive for zero... "pursuing transportation completely free of fatalities and injuries" (City of Calgary 2014). The plan is also built around the values of the Safer Systems Approach (safer infrastructure, safer users, safer speeds, and safer vehicles), continuous improvement (short-term target toward the long-term goal), evidence-based strategies (Engineering, Education, Enforcement, Evaluation, and Engagement), collaboration (internal, external, and community), and best practices (research, technology, and innovation).

The *Calgary Safer Mobility Plan 2019–2023* builds on the work completed during the previous term (2013–2017) with simplification of targets, increased funding, and investment in infrastructure, and continued focus on partnerships, collaboration, and engagement. Vision Zero takes a more-prominent position in the document continuing the vision of "mobility free of major injuries and fatalities" (City of Calgary 2018b, p. 2). The numerical target of 25% reduction over a five-year period is set for both major injuries and fatalities, as well as for all road users and vulnerable road users. The City of Calgary has supporting documents that identify improvements to its transportation infrastructure to support safer outcomes for users. These documents include the Calgary Cycling Strategy, the Complete Streets Guide, the Pedestrian Strategy, and the Traffic Calming Guide, and the overarching policy documents the Calgary Transportation Plan and the Municipal Development Plan.

### Countermeasures

#### Community Traffic Safety Meetings

Community traffic safety meetings are a joint activity between City staff and Calgary Police Service, and are attended by partners of the Safer Mobility Operations and Community Teams. These events include presentations about traffic safety issues and initiatives by City and police staff as well as discussions with citizens about their concerns. Concerns are received and form another piece of information to guide safety improvements and citizens are made aware of ongoing work and programs that they can access for assistance with their concerns.

### Rectangular Rapid Flashing Beacons

Calgary led the national development of traffic control guidelines for the use of Rectangular Rapid Flashing Beacons (RRFBs) through TAC (Transport Association of Canada n.d.). RRFBs use LED lights in rectangular arrays and with a varying flash pattern to alert motorists to the presence of pedestrians at signed and marked crosswalks. The pilot study in Calgary demonstrated dramatic improvements in yielding behavior, from about 70% before, to 90% + post installation (Mishra et al. 2015).

### Traffic Calming Policy and Investment in Changing Infrastructure

The Calgary Police Service (CPS) has a dedicated Traffic Safety Unit that responds to community concerns through their Traffic Service Request program. The CPS also runs staffed enforcement of traffic laws through its Districts and with Mobile Photo Enforcement vehicles using Traffic Section staff, as well as static enforcement at intersections using Intersection Safety Devices that enforce red-light-running violations as well as speed infractions during green lights. Calgary Intersection Safety Devices were included in studies completed by the Province of Alberta about the effectiveness of red-light cameras and speed cameras (AECOM 2014a, b).

Calgary has also invested in changing infrastructure. Roundabouts have increasingly become a traffic-control method of choice when traffic conditions allow. Many new communities are being built with roundabouts as the preferred intersection type for larger roads within communities. A network review of roundabouts in Calgary found that collision rates at roundabouts are less than half of those at signalized intersections (J. Domarad, personal communication, April 15, 2016). Calgary was also the first city in Canada to have an operational Diverging Diamond Interchange (City of Calgary 2019a). This interchange type applies principles of roundabouts to an interchange design by changing left-turn conflicts to merge/diverge type movements.

Further, one of the many network reviews completed in the city as a part of the Safer Mobility Plan was a review of all divided roadways to assess the need for median barriers to prevent or reduce cross median collisions and to prioritize based on collision history (Mishra and Churchill 2014). The use of High Tension Cable Barriers, where space and conditions allow, has been adopted to minimize the risk to vehicle occupants.

Calgary has also piloted and adopted Traffic Calming Curbs to rapidly change the built environment at a low cost (Churchill et al. 2017). These devices are best used as temporary measures to prototype potential changes and evaluate the benefits to advocate for more permanent changes. The City of Calgary received the TAC 2019 Road Safety Engineering Award for the invention and use of this device (City of Calgary Newsroom 2019).

Calgary has been using computer vision technology to quantify near misses using Video- Based Conflict Analysis as well. The proactive collection of conflicts allows evaluations and adjustment to designs to minimize risk, rather than waiting for collisions to occur so that they have data to analyze. Although this is a developing field, the benefits of making corrections to designs are clear, and the City is looking to move beyond traditional reliance on collisions as a design input.

Harmonization of School Zones and Playground Zones
Calgary had reduced speed zones (30 km/h) near school zones and playground zones that had different start and end times and days during which they were in effect. Two stages of harmonization took place: the first stage harmonized the times to start at 7:30 a.m. and end at 9:00 p.m.; the second stage converted all school zones (only in effect on school days) to playground zones that are in effect 365 days a year. The pre-post study revealed that speeds reduced by 6 km/h on average and resulted in a significant improvement in safety in those zones (Mishra and Kattan 2017).

Review of Neighborhood Speed Limits
The City is reviewing unposted and posted speed limits for neighborhoods in 2019 (City of Calgary 2019b). The review includes extensive education and stakeholder engagement, evaluation of alternatives, supporting traffic calming, and potential changes to enforcement. Council has requested a recommendation by the end of 2019 and this may be a significant step toward Vision Zero.

#### Role of Partners

Collaboration is a focal point of the plan and internal and external stakeholders are engaged through four groups that work in concert to advance the actions in the plan. These groups are the Safer Mobility Leadership Team, The Safer Mobility Operations Team, The Safer Mobilities Communities Team, and the Safer Mobility Research Team; additional information about membership of these teams is provided in the Safer Mobility Plan. The City of Calgary is actively involved in the exchange of information with other municipalities directly and through the TAC, CARSP, Institute of Transportation Engineers (ITE), Canadian Association of Chiefs of Police (CACP), and other organizations.

### City of Fort Saskatchewan

#### Background

Located in Alberta's industrial heartland, and to the northeast of Edmonton, The City of Fort Saskatchewan is home to 26,942 residents (City of Fort Saskatchewan 2019a). The city hosts many community events throughout the year, encouraging residents to use the city's roads and more than 75 km of paved walking and biking trails to travel throughout the community (City of Fort Saskatchewan 2019b). Two major highways transect the city and accommodate about 50,000 vehicles per day through each major intersection, many of which transport dangerous goods (City of Fort Saskatchewan 2019b). It has been estimated that about 608,090–680,849 commercial vehicles travel annually through the corridor (City of Fort Saskatchewan 2019b).

In 2018, Fort Saskatchewan had 43 fatal and injury collisions (City of Fort Saskatchewan 2019b). While this is a significant decrease from previous years, the city remains committed to reducing this number to zero. Fort Saskatchewan introduced a new traffic safety plan for 2019–2022, which continues their commitment to Vision Zero.

#### Vision Zero

The City of Fort Saskatchewan adopted Vision Zero and the Safe System Approach in 2018 as their main approach to traffic safety. The five E's of traffic safety – engineering, education, enforcement, engagement, and evaluation – form the foundation of their effort to make the city's roads safer. While the plan supports Alberta's traffic safety strategies for community-based delivery of traffic safety programs, initiatives, and communications, as well as the Capital Region Intersection Safety Partnership joint vision, Canada's Road Safety Strategy 2025, and RCMP Traffic Services Safety Strategic Plans, it is also designed to meet the needs of Fort Saskatchewan (City of Fort Saskatchewan 2019b).

The plan aims to enhance the safety of motor vehicle drivers, bicyclists, and pedestrians on roads, pathways, and trails, with four main objectives: reducing the number and severity of injury and property damage collisions through identifying top five collision locations and the causal factors, and developing a strategy to reduce frequency and severity; enhancing traffic education; identifying and removing impaired drivers from roads; and identifying and sharing engineering concerns with the City's infrastructure department to improve road safety.

#### Countermeasures

##### Education

Fort Saskatchewan places a focus on working with the public and partners to educate all road, pathway, and trail users in the city. The City implements countermeasures, such as speed display boards, to increase driver awareness of speed, and encourage them to comply with applicable traffic laws. Option 4 programs are also available as an educational opportunity. Enforcement is focused on a specific risk factor. Any resident who receives a ticket can attend an educational session to learn about the risks associated with their violation and, upon proof they have attended a session, the ticket will be converted to a warning. The City notes that the results from this option have been exceptional, with residents commenting on their new understanding of traffic risks and desire to change their behavior.

Various education opportunities are available for youth as well. Bicycle rodeos are designed to teach youth about riding bicycles safely and each participant's bicycle is fixed if there are any safety issues present. If participants need new helmets, they are donated by Protective Services and Prairie EMS. Further, school traffic safety training is offered by RCMP and municipal enforcement. Officers deliver classroom presentations on topics such as school bus and pedestrian safety, drug and alcohol topics, and the laws around motor vehicle equipment.

Finally, internal education is offered to officers to increase their awareness of collision contributors in the city, which also involves ongoing data analysis, and development of strategies to reduce collisions. The Municipal Enforcement Services supervisor also distributes messages to the public through local media and their website on a weekly basis, which focus on emerging traffic safety needs.

#### Enforcement

The City of Fort Saskatchewan uses both conventional and automated enforcement to help enforce traffic laws, create awareness about traffic safety, and encourage compliance from the public. Enforcement is enhanced in key areas, including school, playground, and high- collision locations. Photo-laser and intersection safety cameras are also installed to provide automated enforcement.

#### Engineering

The City also places an emphasis on designing safe roads and creating and implementing effective traffic control devices. To do so, a portion of revenue from traffic fines goes toward furthering traffic safety in priority areas. Engineers in Fort Saskatchewan have also developed a policy for traffic calming that will be considered in the development of any new roads.

#### Evaluation

Fort Saskatchewan also assesses the effectiveness of its education, enforcement, and engineering initiatives. The City's Protective Services department has an analyst responsible for traffic analysis who provides the RCMP and Municipal Enforcement Services officers with weekly collision reports, making note of any trend updates. Any repeat violators or violators considered to be high risk are contacted to engage in a discussion on traffic safety. Further, Protective Services also partners with Capital Region Intersection Safety Partnership, supporting traffic safety priorities in the province every year, including participating in Selective Traffic Enforcement Program initiatives. The City notes that, regardless of the strategy used, it evaluates the strategy for efficacy and adjust in any way necessary to meet the needs of the community.

#### Engagement

Fort Saskatchewan works with members of the community in determining areas of concern and aims to engage the community to resolve traffic safety issues in the city. A Traffic Safety Working Group has been formed, including multiple departments in the City and members of the community, to discuss road safety concerns and enforcement trends to help contribute to innovative road safety solutions. Protective services also have held a Town Hall session for members of the community to share concerns, and it also offers an online service tracker where community members can submit service requests, including traffic-related services.

#### Summary

The rural city of Fort Saskatchewan has seen immense success with its traffic safety initiatives and countermeasures. Since 2008, the city has seen a 59.1% decrease in the rate of fatal and injury collisions (City of Fort Saskatchewan 2019b). Thus far, the city has installed nine intersection safety cameras and additional photo-laser devices, has conducted eight pedestrian safety presentations, and has also lowered speed limits in select areas, redesigned major roadways, and improved street lighting (City of Fort Saskatchewan 2019b). There has been a 71% decrease in red light violations at intersections with intersection safety cameras, a 35.8% reduction in overall fatal and injury collisions despite population growth, and $6.98 million in savings due to collision costs in 1 year (City of Fort Saskatchewan 2019b).

#### Role of Partners

The Director of Protective Services chairs a Traffic Safety Working Group that brings together traffic engineers, transportation and roads staff, Municipal Enforcement Services officers, RCMP traffic officers, the Fire Services, representatives from both School Boards, and the Regional Coordinator for Alberta Infrastructure and Transportation. On an ad-hoc basis, subject matter experts contribute to the group's planning and discussions. Their contributions have been incorporated into the traffic safety plan. The Traffic Safety Working Group also includes members of the community, and the group meets to discuss road safety concerns and enforcement trends to help contribute to innovative road safety solutions.

## Ontario

### City of Toronto

#### Background

Toronto is Canada's largest city, with more than 2.8 million residents (City of Toronto 2016). One quarter of Toronto's public space is made up of roads (Toronto Centre for Active Transportation n.d.), and more than three million trips are made to destinations across the city on any given weekday (City of Toronto 2016). Toronto currently houses 5,600 km of roads, 130 km of expressways, 9,500 streets, 26,300 intersections, a 900 km cycle network, 8,000 km of sidewalks, 480 pedestrian crossovers, and one million traffic signs (City of Toronto 2016).

In 2018, there were 66 people killed and 346 people seriously injured on Toronto's roads (City of Toronto 2019a). Nearly 82% of traffic fatalities involved vulnerable road users, such as pedestrians, cyclists, and motorcyclists (City of Toronto 2019a). Of all those involved in fatal collisions in Toronto in 2018, 62% were pedestrians, 18% were in cars, 14% were on motorcycles, and 6% were on bikes (City of Toronto 2019a). Safe streets in Toronto are critical to ensure that residents and visitors can move about safely, regardless of location, time of day, or mode of transportation.

#### Vision Zero in Toronto

After 2 years of development with 12 partner agencies and approval from Toronto City Council, the City of Toronto introduced its 5-year *Vision Zero Road Safety Plan (2017–2021)* in 2016. Given the size and complexity of Toronto, the City takes a data-driven approach to effectively prioritize safety improvements based on location and specific needs. Considering KSI collision trends and geospatial analysis, the City identified collision patterns, such as most vulnerable road users, circumstances surrounding KSI collisions, and collision hotspots (City of Toronto 2016). This data was used to establish emphasis areas and countermeasures.

The *Vision Zero Road Safety Plan* outlines six emphasis areas: pedestrians, school-age children, older adults, cyclists, motorcyclists, and aggressive and distracted driving. The 2016 plan outlines more than 50 countermeasures to address each emphasis area and related road safety risks. In year one, Toronto focused on the reduction of Killed or Seriously Injured (KSI) collisions. As the plan has continued to evolve, the city has been looking to prevent collisions before they happen with collision forecasting and a focus on causal factors. To refocus efforts and enhance progress, Toronto City Council approved *Vision Zero 2.0* in 2019.

#### Vision Zero 2.0

*Vision Zero 2.0* represents a renewed commitment to the Vision Zero approach and an updated focus on efforts that will be most effective in achieving Toronto's road safety goals, as well as the addition of Heavy Trucks as a seventh emphasis area. The plan will focus on proactive systemic safety analysis of collisions involving vulnerable road users, speed management strategy, and geometric safety improvements, among various other goals such as additional mid-block crossings, increased police enforcement, and development of district safety plans (City of Toronto 2019b).

In keeping with the City's data-driven approach, staff working on Vision Zero 2.0 are reviewing demographic data, travel behavior, built road environment, five-year KSI trends, type of road users involved in KSIs, severity of collision outcomes, top KSI collision types in emphasis areas, road user actions contributing to KSIs, age of drivers and collision victims, relationship between road classification and KSI trends, relationship between time of day, month, light condition and KSI trends, hotspot mapping of intersection and mid-block KSIs, and public opinions on road safety (City of Toronto 2019c).

#### Countermeasures

##### Programs, Initiatives, and Strategies

There are a number of programs in place to address each emphasis area in Toronto's plan. The "Missing Links" Sidewalk Program includes a policy to install sidewalks in areas with no sidewalks or where there are gaps in the sidewalk network to ensure that all pedestrians can travel safely to and from their destination. The Geometric Safety Improvements Program implements road improvements and changes to intersection design to address safety issues. New in the plan, pedestrian safety corridors are being installed and include measures such as targeted speed limit reductions, signal timing adjustment, and enhanced crosswalk markings. A local road pedestrian crossover pilot has been conducted to assess the possibility of new types of pedestrian crossovers to enhance protection for pedestrians as well.

School-age children are an emphasis area in Toronto's Vision Zero plan, with the establishment of School Safety Zones around all schools being a key undertaking to help raise awareness of drivers to the presence of school-age children in the area and lower speeds. School Safety Zones include lower speed limits, increased enforcement, improved pavement markings, and flashing beacons and LED display signs. The School Crossing Guard Program is being reviewed as part of a recent transition of the program from the Toronto Police Service to City of Toronto. The plan also outlines a community-based initiative to plan active, safe routes to school, and the bicycle helmet initiative promotes helmet use and wheeled-transportation safety among school children.

To address the safety of older adults, Toronto has implemented "Senior Safety Zones" to introduce measures to improve senior road safety at high-priority locations. These include lower speed limits, advance green lights for pedestrians, watch your speed driver feedback signs, additional mid-block crossing opportunities, increased crossing times at signals, decreased crossing distance, increased enforcement, and improved pavement markings. A Priority Snow Removal Program is also offered, which allows adults over the age of 65 to apply to have snow removed in front of their residence. Bringing an Awareness of Senior Safety Issues to the Community (B.A.S.S.I.C.) delivers safety seminars and a safety calendar to improve the safety of older adults on Toronto's roads. The City's overall "Senior's Strategy" features an accountability table to ensure all issues affecting senior citizens, including transportation and road safety, continue to be a priority.

In 2016, Toronto introduced the Ten Year Cycling Network Plan, which aims to improve safety for cyclists. The City has installed cycle tracks, bike lanes, shared lane pavement markings, and multiuse trails (City of Toronto 2019d). The City will continue to improve cycling infrastructure in the coming years. There are also a number of intersections across Toronto that are being protected for cyclists as part of a pilot project. Further, motorcyclists are at risk on busy city roads, due to the lack of protection, higher speeds, and their limited visibility for other drivers on the road. Project E.R.A.S.E is supported by Toronto Police to address motorcyclist safety and reduce illegal street racing.

#### Enhanced Enforcement

Enforcement activities are emphasized in Toronto's Vision Zero plan and are done in collaboration with Toronto Police Service and Ontario Provincial Police (OPP). Enforcement strategies are data-driven, meaning police are provided with reports identifying the locations where there have been the most collisions in each emphasis area. Automated enforcement, such as speed enforcement and red-light cameras, are being installed in priority areas. The Red Light Camera program will be doubled in size in 2020 to meet growing demand, Areas where new safety measures are implemented, such as new mid-block crossings, receive enforcement support as well (City of Toronto 2016).

Enforcement strategies are tailored to each emphasis area and focus on priority locations. In school zones, enforcement focuses on offenses relating to pedestrian crossovers, school zone speed limits, intersections, school crossing guards, stopped school buses, and parking regulations. Additionally, enforcement will be enhanced around driver behavior that compromises cyclist safety, such as improper use of bicycle lanes and cyclist infractions to improve understanding of laws. Motorcyclist safety and aggressive and distracted driving will be targeted with enhanced enforcement efforts and enforcement has also increased in areas frequented by older adults (City of Toronto 2016). Police have also run "Operation Impact," an enforcement campaign targeting distracted and aggressive driving.

#### Educational and Awareness Campaigns

Education and awareness initiatives are run by various road safety delivery partners including Toronto Public Health, Toronto Transit Commission, School Boards, Toronto Police, and City of Toronto and are developed for each emphasis area. These initiatives help build skills, educate and raise awareness of safety risks and steps to improve safety for road users. Targeting pedestrian safety, the "March Break March Safe," "Stay Focused Stay Safe," and "Step Up Be Safe" campaigns enhance education, awareness, and enforcement of pedestrian safety, including issues such as unsafe mid-block crossings and vulnerable road users committing offenses near pedestrian crossovers. Further, road safety of older adults is addressed through Sunnybrook Health Sciences Centre's iNavigait campaign, which helps to ensure the safety of seniors, addressing dangers for older adults on roadways.

Additional campaigns, including the "Please Slow Down" campaign by the City, which provides residents with lawn signs to encourage drivers to slow down, and "You Know You Shouldn't... So Don't" campaign, a series of YouTube videos addressing aggressive driving, have also been implemented to target aggressive driving. To address motorcyclist safety, the Spring Motorcycle Awareness Campaign was designed by Toronto Police to coincide with the start of motorcycle season, focusing on equipment safety, rider protection, and training. Similarly, educational materials exist for cyclists, including helmet safety videos and the Toronto Cyclists handbook, which teaches about traffic laws and safe cycling. "Space to Cycle," an educational campaign led by Toronto Police Service that focuses on motorists whose actions endanger the lives of cyclists and risky cyclist behavior on roadways, and the "Stay Safe, Stay Back" campaign, which promotes safe interaction between cyclists and large trucks, are also run to promote cyclist safety.

#### Pavement Markings

Pedestrian crosswalk enhancements have been made, including pavement markings, zebra stripes at crossings, increased crosswalk widths, and stop bars. Toronto has also designated cycling conflict areas, where green pavement markings are implemented at or near intersections to highlight conflict areas between cyclists and motor vehicles. Bike boxes are painted to ensure that cyclists can proceed first at a green light and cross intersections safely and existing pavement markings delineating cycling infrastructure are refreshed on an ongoing basis. The City is also implementing painted intersection corner bump-outs with bollards as interim geometric safety modifications in advance of capital road work.

#### Traffic Control Signal Changes and Enhancements

The installation of LED blank-out signs is being piloted to depict prohibited left and right turns (City of Toronto 2016). Signalized crossings and advanced green lights for pedestrians and cyclists are also being expanded across the City, as well as no-right-turn-on-red prohibitions at key locations (City of Toronto 2016). Additionally, street lighting and accessibility measures at signals are being improved in the plan. Automated cyclist detection is another possible countermeasure under study as a means to optimize intersection operations and reduce the risk of cyclists being unable to pass through an intersection before vehicles (City of Toronto 2016).

#### Speed Management

The City advocates for and plans to pilot automated speed enforcement in school zones and continue to include permanent "watch your speed" display signs in school zones. The mobile "watch your speed" program has been implemented in multiple emphasis areas to address dangerous speeding behavior, as well. The city has also reduced speed limits from 60 km/h to 50 km/h on majority of major arterial roadways with further reductions from 50 km/h to 40 km/h on select roads. The multi-year plan is to reduce most collector roadways to 40 km/h and local residential roadways to 30 km/h in some areas, using neighborhood gateway signage and pavement marking. Additionally, new corner radius design and right slip lane replacement is being looked at to reduce speed and improve safety.

#### Data-Analysis and Safety Assessments

Toronto regularly analyzes collision data to determine trends and the need for interventions. When the data show that collisions are increasing or failing to improve, this represents the need for more countermeasures in those areas and a look at which are effective, and which may not be doing what they are intended to do. The City of Toronto analyzes data to understand the needs of the public and priorities to ensure they spend their budget appropriately. An example is a systemic review of high-risk mid-block crossing locations. The analysis will help identify the location of new signalized mid-block crosswalk by taking into account pedestrian desire lines and attractors in addition to other variables. Another example is the data-driven approach to the widescale rollout of Leading Pedestrian Intervals (LPIs) over the next several years.

Further, the city developed a "Traffic Calming Guide for Toronto" to review typical traffic calming options, including their cost and effectiveness, and the City and Toronto police aim to implement data-driven enforcement strategies as well. Road safety reviews will be required to address pedestrian safety and the approach to aggressive and distracted driving outlines enhanced data collection, analysis, and reporting (City of Toronto 2016).

#### Summary

In 2018, the City launched the Active and Safe Routes to School pilot at five schools, deployed mobile watch your speed signs in every Toronto ward, made numerous cycling enhancements, ran a pilot for rapid deployment of geometric safety improvements, improved street lighting, and held various public education campaigns, to name just a few achievements (City of Toronto 2018). To date, the City of Toronto has also installed 510 community safety zones, 64 senior safety zones, 156 school safety zones, 63 traffic signals, and pedestrian crossovers, 146 pedestrian head-start signals, 78 red-light cameras, 239 accessible pedestrian signals, and 21 LED blank-out signs (City of Toronto n.d.).

#### Role of Partners

The City of Toronto's *Vision Zero Road Safety Plan* was developed using a collaborative approach with partner agencies, external stakeholders, advocacy groups, and the public. Partners on the plan include those that have supported and worked on road safety, including Toronto Police Service, Toronto Public Health, Toronto Transit Commission, the Disability, Access, and Inclusion Advisory Committee, CARP, Toronto Seniors Forum, the Canadian Automobile Association (CAA), Cycle Toronto, Walk Toronto, Toronto District School Board, Toronto Catholic District School Board, Sunnybrook Health Sciences Centre, the Rider Training Institute, Motorcycle and Moped Industry Council, The Centre for Active Transportation, Culture Link, Friends and Families for Safe Streets, and Sick Kids Hospital. A representative from each of the five main delivery partner agencies also forms the Vision Zero Road Safety Working Group, which meets quarterly to review progress, priorities, issues, and plan future Vision Zero initiatives.

The Toronto Police Service assists with enhanced enforcement and runs a number of campaigns and projects aimed at enhancing road user safety. Partner organizations, such as Cycle Toronto, assist with producing materials such as the Toronto Cyclists Handbook. Other partner organizations, such as Sunnybrook Health Sciences Centre, Toronto Public Health, and CAA, run programs for target populations, such as older adults and school children. Each partner uses their expertise to contribute to and enhance countermeasures.

## Québec

### Ville de Montréal

#### Background

Montréal is the largest city in the province of Québec: its one million population (rising up to four million in the metropolitan region) represents a vibrant society and the city was the top economic performer in the country in 2018 (Conference Board of Canada 2018). This context led to many initiatives in transportation to boost the economy and to curb congestion and road safety issues. Accordingly, major issues were raised in the 2008 Transportation Plan and road safety was embedded in two of the 21 initiatives that are part of this plan: implement a Pedestrian's Charter and increase roads safety through education, enforcement, and engineering. These initiatives were partly implemented in the following years, including the establishment of a Transportation Safety Office within the city, and the systematic review of intersection design where there were too many collisions.

Despite these efforts, the decrease in road injuries seen in the early 2000s is now stagnant: there is still an annual mean of 14 pedestrian, two cyclist, and 10 car occupant deaths, far too many when thinking about the cost of a lost life (City of Montréal 2018). Facing this growing concern, elected officials from the city first launched a Vision Zero initiative in 2016, reinstating the road safety content from the 2008 Transportation Plan. This was seen as a first step toward a real Vision Zero action plan, which was officially launched in 2018.

#### Vision Zero in Montréal: Three Goals to Achieve Best Practices

Montréal's Vision Zero action plan (2019–2021) is based on three major themes: promote collaboration, change attitude, and transform the road system. Each theme has several related actions to be taken within the first 3 years. As in other Vision Zero cities, the first step to embrace Vision Zero principles relies on the creation of a strong, participative, and interdisciplinary governance, convinced of the benefits of this change in the road safety paradigm.

To promote collaboration, the city is moving forward with five actions: Provide leadership that will create a ripple effect throughout the Montréal community and bring Vision Zero to life over time; Develop collaboration to ensure the sustainability, integrity, fairness, and transparency of Vision Zero; Develop effective communication channels among the city, partners, and citizens; Share responsibility for the safety of the street network among all partners; Set common targets to help achieve the overall goal of zero deaths and zero serious injuries.

To change attitude and ways of doing things, the City suggests several actions that can be implemented first within its staff and strongly encourages partners to do the same within their workforces: mobilize road system designers and managers to increase safety and let them become change agents; foster interdisciplinary development and dissemination of new knowledge to better understand our environment; measure ways of doing things and intervene more effectively; accelerate the implementation of best road-design practices through the dissemination of guides and the revision of development standards; better coordinate awareness and education campaigns; and ensure the development and maintenance of driving skills with the appropriate training.

Finally, to transform the road system, the City and its partners target 12 actions: plan road-sharing between the different modes of transport for the entire network in order to offer accessible, safe, and effective mobility options; create safe, user-friendly, and accessible pedestrian walkways, with particular attention to intersections; ensure compliance with speed limits and reduce transit traffic on local streets and in sensitive areas; improve Montréal's standards for the upgrade and deployment of the cycle network; improve the public transit offer and promote its safety as a mode of transportation; better integrate the needs of vulnerable road users into the design and programming of traffic lights; adopt simple, clear, and durable signage and marking to help all road users to understand their meaning; harmonize street lighting to ensure better visibility for all road users; ensure that parking is no longer an obstacle to the establishment of safer infrastructures; ensure a better coexistence between heavy vehicles and vulnerable road users; better adapt construction site management to the reality of vulnerable road users; participate in the development of vehicles safety devices through technological watches or pilot projects.

#### Four Keys to Vision Zero Success: The Montréal Vision Zero Action Plan Has Them All!

One interesting point about the Montréal Vision Zero action plan is the clear presence of the four essential elements for Vision Zero success. First, many actions in all themes will help to develop new knowledge in road safety, both within and outside the city staff. This new know-how can then be used to change the way we see the road system to better include users' vulnerabilities and to build it so potential mistakes are forgiven.

Secondly, the strong will found in the action plan to work in partnership is the right answer to the four "Ps" needed to achieve Vision Zero: strong support from the Politics in power, the Public servants, including City and police staff, the Press (a major communication plan is related to this plan), and the Population. This support is first seen by asking as many partners as possible, including Montréal's own city division and teams to be "committed to road safety" by signing the declaration of commitment on its website. There are already several partners committed and more signing each month, either simple citizen or bigger organizations. In addition, the consultation prior to this plan highlighted more than 400 local initiatives in road safety across the city, coming from either city's services, nonprofit, or private firms. This confirms the partners' awareness of the role they can play in improving the safety of the road system.

Third, there are many evaluation and feedback opportunities embedded in the action plan, two major points when it comes to evaluating the success of actions in a Vision Zero approach. The first feedback loop is within the governance plan, where there are three thematic working groups (crosswalks, heavy vehicles, and speed management), one advisory committee (vulnerable road users), and one committee on data management in charge of producing an annual road safety statistics report. All these committees will be listened to by the city staff responsible for the VZ action plan.

Finally, this first Montréal Vision Zero plan also provides budget and dedicated staff for the implementation of actions and also for the evaluation of the effects. For example, the first theme includes an action to "create a Vision-Zero-dedicated team and filling seven additional positions for the implementation of the action plan," and the second and third theme include budget for research, including the evaluation of pilot projects.

#### Summary

Between road infrastructure maintenance and the need for more sustainable mobility, the city of Montréal Vision Zero action plan is a good start to make sure that road safety challenges, such as safe speed in local neighborhoods, new technologies and distracted driving, and aging of the population are addressed. This three-year plan is promising by its content and the willingness it depicts from several key actors. The whole road safety community is looking forward to seeing the impacts of this first plan.

### Role of Partners

The City of Montréal outlined from the beginning that collaboration would be essential to its Vision Zero strategy. Accordingly, more than 30 local and provincial stakeholders signed a declaration of commitment in the first City's VZ Action Plan (City of Montreal, 2019: https://portail-m4s.s3.montreal.ca/pdf/vision-zero-ville-de-montreal-2019-2021.pdf). The governance model found in this first action plan is based on interdisciplinarity, including several working groups where four priorities were set by participative stakeholders: speed, heavy vehicle, road crossing, and data management (City of Montreal, 2021: https://portail-m4s.s3.montreal.ca/pdf/etat_de_la_securite_routiere_2020vdem_0.pdf).

Partners were involved in the development of Montréal's Vision Zero plan. After a synthesis of Vision Zero components was developed based on a literature review and case studies, the City of Montréal held meetings with key stakeholders. These meetings included personnel from the public health department, the police department, and public transportation agency, resulting in an evaluation of the safety of Montréal's road network in regard to each component of Vision Zero. Recommendations were then made by comparing the results and, in collaboration with City staff, actions were prioritized according to current opportunities in the city (WSP 2018).

## Looking Toward the Future

Government plays a leading role in the uptake and implementation of Vision Zero as the resources for planning, development, implementation, and evaluation reside with the jurisdiction responsible for road safety, whether that is the provincial, territorial, or municipal level. Advocacy by government officials helps to make a valid case for funding and, for a plan such as Vision Zero, which aims to make large-scale changes, government co-operation, and advocacy are essential.

As important, the public drives demand for Vision Zero, setting out the expectations people have from their city and the streets that run throughout it. The public brings awareness to road safety issues, drives community engagement, plays a key role in getting Vision Zero on the agenda and in getting it implemented city-wide. Public opinion can inform effective progress, enhance cooperation, and adherence to road safety rules, help those involved in Vision Zero planning to understand perceptions and behaviors of road users, and allow the city to tailor its Vision Zero efforts to specific road user needs.

Data-driven approaches to Vision Zero allow a regular analysis of collision data to determine trends and the needs of the public and priorities for interventions. Robust evaluation methods can track the successes of countermeasures implemented and look at which are effective and which are not doing what they are intended to do. The countermeasures implemented must be convenient, appealing, and demanded by the public for them to be put to use. Evaluation data can demonstrate success and ensure support from the public, government, partners, and stakeholders for ongoing and future Vision Zero initiatives. The demonstration of a jurisdiction's success also helps encourage other cities to adopt Vision Zero in their road safety plans.

Vision Zero continues to gain momentum across Canada and the idea of creating more livable cities is sparking conversations across sectors. However, it is not without its challenges, whether that is criticism directed at the types of actions being taken, the speed or lack thereof of the implementation process, the location of interventions, the debate among road users, and their rights to use the roadways or the perception that the goal itself is not achievable. It is critical to look at the progress that has been made and consider how Vision Zero can continue to be effectively implemented and the most efficacious solutions are widespread moving forward, including application in different sectors. It is firstly important to outline Vision Zero priorities for the future. Key Vision Zero priorities include: raise awareness of the issue and tie to global initiatives whenever possible; align the efforts of various levels of government (while cities are the lead, provincial, and federal government should be involved as well); ensure there is money to implement action plans; communication between jurisdictions to exchange best practices; align the efforts of ministries and departments within the various levels of government; overall, make road safety a national priority. Ensuring road safety is at the forefront of public attention and government support will help all jurisdictions to move forward.

For Vision Zero to be successful, there needs to also be an overarching agreement on the issues and the systems nature of the problems and the required solutions. Doing so will allow for larger changes to be made, rather than taking small, and sometimes less-effective steps toward zero. A welcome opportunity is the drive to collaborate and share information among local jurisdictions and disciplines, which provides the potential to create political pressure to keep up with others and leverage lessons learned to accelerate improvements in road safety.

Vision Zero is an approach with a goal of zero serious injuries and fatalities and an emphasis on preventative measures that accommodate for human error; and this approach does not have to be limited to road safety. This approach has applicability to various public health topics and injury prevention efforts, because one preventable death is too many.

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# Adoption of Safe Systems in the United States

17

Jeffrey P. Michael, Leah Shahum, and Jeffrey F. Paniati

## Contents



J. P. Michael (✉)
Center for Injury Research and Policy, Johns Hopkins University, Baltimore, MD, USA
e-mail: jmicha30@jhu.edu

L. Shahum
Vision Zero Network, San Francisco, CA, USA
e-mail: leah@visionzeronetwork.org

J. F. Paniati
Institute of Transportation Engineers, Washington, DC, USA
e-mail: jpaniati@ite.org



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**Abstract**

Safe Systems are in early phases of implementation in the US. Adoption of these concepts in the USA has been slower than in a number of other nations, including Sweden, The Netherlands, UK and Australia. Whereas adoption in other nations began as early as the late 1990s, interest in Safe Systems in the USA followed by about a decade. One factor associated with this delay is the success that the USA experienced with public safety and compliance methods, such as high-visibility traffic law enforcement, during the period in which the Safe System movement took hold in other countries.

National road safety professional organizations were among the first in the USA to shift toward zero-focused strategies. City and state governments followed and the federal government took steps in this direction after local and state efforts were well underway. By 2020, discussion of Safe Systems was taking place in national professional associations and early steps had been taken toward federal institutional support.

Although implementation in the USA is not yet widespread, lessons have been learned in building public and political support for Safe Systems. Managing public expectations regarding short-term safety benefits is likely to be a key to longer-term Safe Systems support. Increased efforts are needed to inform political leaders at the local, state and national levels of the benefits of Safe Systems and Vision Zero as well as additional education for safety practitioners.

**Keywords**

Safe system implementation · Vision zero history · U.S. traffic safety · Safe system approach · Zero traffic deaths

## Introduction

While Safe Systems and Vision Zero are synonymous or near-synonymous in many areas of the world, the terms have evolved with slightly different meanings in the USA. A number of jurisdictions across the nation have adopted programs using Vision Zero terminology that incorporate some, but not all, of the principles commonly associated with Safe Systems. These jurisdictions typically focus on the ethical imperative of reaching zero traffic deaths, but recognition and adoption of other Safe System principles varies widely, including system design that accommodates human error and reduces the level of kinetic energy in crashes, and a shared responsibility for crashes by system owners. In communities where the full Safe System concept has yet to be institutionalized, Vision Zero is sometimes used as part of public campaigns that seek behavior changes such as reduced speeding and distracted driving.

The term, Safe Systems, is used primarily among safety professionals in the USA. While the term has yet to become part of the daily professional vernacular, when it is used, the implied definition is typically close to the commonly understood Safe

Systems principles. This chapter will address the background, status, and trajectory of both Vision Zero and Safe Systems, using these US terminologies.

## Early Consideration

In the late 1990s, as Scandinavian countries were securing Parliamentary endorsement for Safe Systems (Belin et al. 2012), the United States was experiencing a period of unprecedented success in behavioral road safety using a different approach, high-visibility law enforcement. The *Click-It or Ticket* seat belt program was launched in the State of North Carolina in 1993, adopting a technique that had shown promise in Canada and elsewhere, using an aggressive statewide implementation strategy (Tison and Williams 2010).

The effect of the *Click It or Ticket* high-visibility law enforcement technique was sufficiently positive that national attention was soon focused on this approach. Federal leadership, along with support from the automotive and insurance industries, further encouraged state and local adoption. In 2000, other states followed the North Carolina example, and in 2002, federal incentive funding was linked to state adoption of the *Click It or Ticket* program, and a coordinated nationwide campaign was launched to further encourage implementation (Runge 2002).

With federal, state and corporate safety leadership focusing on high-visibility law enforcement, relatively little attention was given in the USA to the road safety innovation occurring in Sweden, The Netherlands and later, Australia, the UK and other countries. As early as 1999, the Federal Highway Administration issued a technical report including a detailed description of the new Swedish Vision Zero program (Federal Highway Administration 1999), however this news did not stimulate widespread interest or action at the time. In 2000, the State of Washington became the first jurisdiction to adopt a zero traffic death policy, referring to their program as Target Zero (Washington Traffic Safety Commission 2019).

By 2007, several indicators of state and local implementation of the *Click It or Ticket* program began to show declines, including law enforcement activity as measured by seat belt tickets issued per population, investment in publicity about seat belt law enforcement, and public awareness of enforcement activity immediately following the coordinated national implementation campaign (Nichols et al. 2016). Various factors may have contributed to the decline in state and local high visibility enforcement activity. Earlier reports cited competing demands on enforcement agency budgets and personnel resources, along with increasingly complex criminal issues, as contributing to reductions in traffic law enforcement (Wiliszowski et al. 2001).

A reduced emphasis and investment in high-visibility traffic law enforcement may have stimulated interest in alternative safety approaches, including Vision Zero and Safe Systems. Among the first US cities to make public commitments consistent with Vision Zero principles was the City of Chicago. An Action Agenda published by the Chicago Department of Transportation in 2012 established a 10-year goal to eliminate traffic deaths (Chicago Department of Transportation 2012). The Action Agenda did not specifically cite Vison Zero or Safe Systems, but included several of the underlying principles, including a systemic approach to crash injury reduction and acknowledgement of human injury tolerance and its relationship to vehicle speed, in addition to the ethical imperative of a zero-fatality goal.

## Focus on Zero

In 2014, a group of eight organizations representing government agencies at state and local levels released *Toward Zero Deaths: A National Strategy on Highway Safety*. The result of 5 years of development, including multiple levels of stakeholder engagement, the Toward Zero Deaths strategy was a substantial step forward in several respects.

Through a series of webinars and workshops, the development process brought together an extraordinary range of safety professionals, including representatives of agencies with responsibility for driver licensing, law enforcement, road construction and maintenance, commercial vehicle regulation, road user behavior, and emergency medical response. Reaching widespread agreement on the importance of a zero-based goal for traffic deaths among these professionals was a critical achievement with far-reaching implications.

A goal of zero traffic deaths can be viewed as contrary to conventional policy development methods that rely on cost-benefit analyses to allocate resources among social needs. A zero-death ethical imperative implies that there is no threshold of traffic deaths – other than zero – that would justify shifting resources away from road safety. This misalignment with conventional safety policy perspectives can be uncomfortable for safety professionals, as was found in Sweden during early years of Safe Systems implementation (Belin et al. 2012). The Toward Zero Deaths strategy made significant progress in overcoming such reservations among US safety professionals, achieving broad consensus on a zero-based road safety goal.

The Toward Zero Death strategy also heightened recognition of the need for a system wide approach to traffic safety. The strategy was developed and presented in a way that emphasizes the need for a comprehensive approach including behavioral, roadway, vehicle, safety management and data systems, and emergency response interventions (Toward Zero Deaths Steering Committee 2015). The strategy includes more than 180 recommended actions across these areas.

The Toward Zero Deaths strategy did not focus specifically on the Safe Systems approach. However, the broad endorsement of the zero-based goal, the inclusiveness of the development process, and the emphasis on a system wide strategy were progressive contributions to road safety thought in the U.S.

## Initial Steps

### Vision Zero Cities

High-profile, city-led activity towards the Safe Systems approach began in New York City (NYC) with the support of a well-organized, politically influential advocacy group, Transportation Alternatives (TA). TA developed a public report in

2011 showcasing the basic Safe Systems concepts, highlighting advances made in other nations, and laying out a blueprint for NYC adoption. The report initially gained the attention of safety advocates and later attracted a broader audience when TA effectively inserted the topic into the 2013 NYC mayoral election. Importantly, all of the leading candidates committed to TA's Vision Zero challenge during their campaigns, and the candidate who won, Mayor Bill deBlasio, tasked his staff almost immediately with developing the city's initial Vision Zero plan. The plan explicitly stated that "No level of fatality on City streets is inevitable or acceptable" (City of New York 2014), and it laid out specific actions to be pursued in roadway design, regulations, enforcement, data-tracking, local and state policy changes, and others.

This early and quick embrace of Vision Zero in NYC can be credited, in part, to the following: effective grassroots advocacy that planted the seeds in a hotly contested election; a "strong-mayor" system in NYC, in which leaders of departments, such as transportation, police, public health, etc., are directed by the city's chief executive; and the nascent and powerful movement among local residents who lost loved ones to traffic injuries and organized for Vision Zero.

This organized voice for victims accelerated change. Now called Families for Safe Streets, the group was formed by those who had lost sons, daughters, husbands, and other loved ones, as well as some who had survived serious traffic crashes themselves. The influence of these individuals in the early days of NYC's Vision Zero development was powerful because their personal and often heart-breaking stories helped move the issue of traffic safety from being viewed as a routine, technical issue to a deeply emotional and urgent rallying cry for change. NYC's Families for Safe Streets group is supported by TA, giving it organizational and administrative backing. However, the group speaks with its own distinct voice, successfully advocating for long-desired policy and legislative changes. This victim advocacy enabled important progress. For instance, members of Families for Safe Streets are credited with helping to pass key legislation in the State of New York, allowing NYC to lower speed limits from 30 to 25 mph and to add automated speed cameras in school zones. Overall, in its first years of Vision Zero commitment, NYC experienced a 31% decline in traffic deaths, from 299 in 2013, the year prior to Vision Zero, to 205 in 2018. Nationwide traffic deaths increased by 12% during the same period. An increase of 16 deaths in NYC in 2019 was a setback, but still amounted to a 26% drop since 2013, just before Vision Zero was adopted (City of New York 2020).

The second US city to adopt Vision Zero was San Francisco, also in 2014. As in NYC, interest was initiated by local advocacy groups, specifically two membership organizations that promoted bicycling and walking. The impetus was an upsurge in traffic fatalities in the city, especially among people walking and biking. Particularly compelling was the highly publicized death of a 6-year-old child hit and killed on New Year's Eve while walking with her mother in a crosswalk. That tragedy occurred on a street where advocates had long been fighting for safety improvements to little avail. Local advocates approached the Mayor, as well as leaders of the transportation, police, and public health departments, and urged adoption and implementation of Vision Zero. City officials agreed and activity built upon the city's strong base of recent work focused on data-driven pedestrian safety planning, which was co-led by transportation and public health officials.

## The Beginning of a National Movement

Following the strong focus on *Click It or Ticket* during the 2000–2005 era, federal leadership in behavioral safety moved on to other emerging traffic risks. Based on the extraordinary success of *Click It or Ticket*, similar high-visibility enforcement approaches were attempted as part of an emphasis on reducing driver distraction between 2010 and 2013 and for improving pedestrian safety in 2013–2015. However, implementation of the high-visibility enforcement approach was less consistent across the nation and results were not as remarkable for these other programs as in the earlier seat belt experience (National Highway Traffic Safety Administration 2014).

By 2016, a combination of factors motivated federal transportation leaders to work with stakeholders to define a longer-term path for road safety in the USA. Changes in public support for strong laws and aggressive law enforcement were diminishing prospects for repeating prior successes with these approaches. Meanwhile, after a decade of gradual declines in road deaths associated with the downturn of the national economy during the Great Recession, traffic fatalities started to rise again (He 2016). Additionally, public interest in the emergence of self-driving cars had reached a point where some safety advocates were concerned that commitment to behavioral safety programs may wane as a result of unrealistic expectations regarding the imminent arrival of fully automated passenger cars.

Federal officials at the US Department of Transportation gathered safety stakeholders in October 2016 to consider options for progress. At this meeting, behavioral health experts reviewed existing traffic safety program strategies and compared them to techniques used in other areas of health behavior change, such as anti-smoking campaigns. This expert review concluded that the current range of program strategies used for improving traffic behaviors – including those recommended in the Toward Zero Deaths National Strategy – compared favorably to those used in other areas of public health. There were few apparent opportunities for improving traffic safety programs by adopting strategies that had proven effective elsewhere. Additionally, experts on vehicle automation pointed out that while self-driving cars promise substantial safety benefit, those vehicles will not reach widespread use for a number of decades, confirming the ongoing importance of road safety behavioral programs for at least 20–30 years.

Also discussed at this conference was the concept of Safe Systems and the experience of Sweden in using this innovative approach to improve the effectiveness of both conventional and emerging safety strategies. At the conclusion of the conference, there was interest in articulating a long-term traffic safety vision for the USA that would describe how conventional evidence-based programs, as recommended in the Toward Zero Deaths National Strategy, might fit together with the future potential of automation and the Safe Systems approach.

## Formulating a Long-Term Vision

In late 2016, a larger group of safety stakeholders was invited to help formulate this long-term traffic safety vision and facilitate its implementation. A Road to Zero Coalition was launched with leadership from the National Safety Council (a non-government organization) in collaboration with three safety agencies of the US Department of Transportation, the National Highway Traffic Safety Administration, the Federal Highway Administration and the Federal Motor Carrier Safety Administration. A Road to Zero Steering Group was formed with representatives from a range of stakeholder organizations. The Swedish Transport Administration was asked for advice and was an active participant in deliberations.

A decision was made by the Road to Zero leadership organizations to develop a 30-year vision for reducing traffic deaths to zero, or near zero, a timeframe that would be long enough to consider the role of emerging vehicle automation technology in achieving this objective, but still within the comprehension or experience of many safety professionals. Assistance in articulating the vision came from the RAND Corporation, a non-profit research institution. The planning methodology presented in Fig. 1 was designed specifically for this purpose, including elements of back casting, assumption-based planning and three-horizon foresight. The vision was formulated over a series of meetings over the first half of 2017. Continued input was solicited from the Steering Group and federal collaborators as drafts were prepared, reviewed and refined throughout the remainder of the year. Coalition meetings were conducted quarterly and membership increased from 150 public and private sector organizations, including cities, nonprofits, businesses, and government agencies at the first gathering, to approximately 900 3 years later.

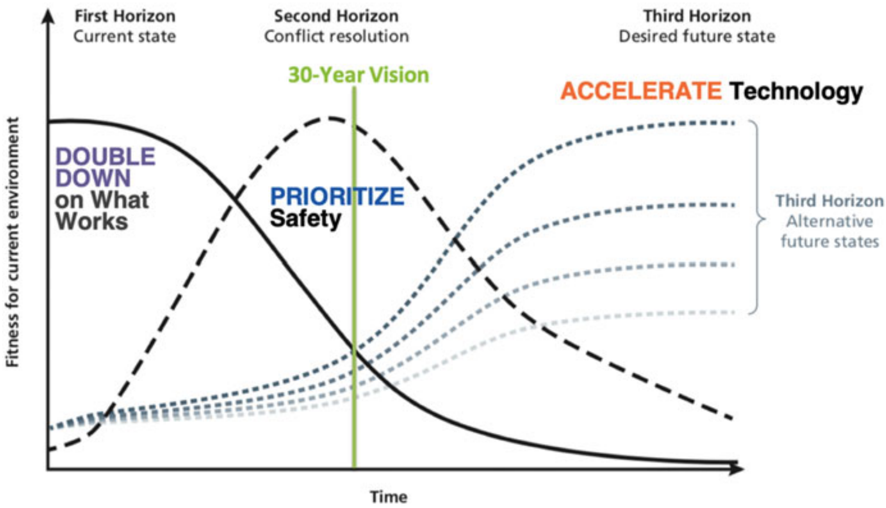


**Fig. 1** Three horizons of change proposed by the Road to Zero vision. (Source: Adapted from Curry et al. 2008)

## The Road to Zero Vision

The completed Road to Zero Vision, released in April 2018, presents a forecast of traffic safety in the year 2050, depicted in a series of community scenarios, along with an explanation of how that future was achieved (Ecola et al. 2018). The 30-year vision predicted by the Road to Zero describes the potential result of investment in three areas or horizons of change: Double Down on What Works, Prioritize Safety, and Accelerate Technology.

The first of these, identified as *Double-Down on What Works*, reflects the potential impact of maximizing implementation of the wide range of evidence-based strategies that have been documented in the fields of roadway engineering, driver and road user behavioral safety, vehicle safety engineering, and emergency medical response and pre-hospital care. These policies and practices are the result of decades of research, development and refinement by engineers, psychologists, physicians, academics and other professionals. They include the most effective and feasible approaches developed to improve road safety, and many of the strategies have yet to be fully implemented and therefore hold unrealized potential. The Toward Zero Deaths National Strategy lists evidence-based interventions that were available in 2015 from across these fields, such as enacting safety belt laws, installing road shoulder and centerline rumble strips, and lowering speeds and creating dedicated bike space in cities. The number of such countermeasures continues to grow as new techniques are developed and evaluated.

The second horizon of change proposed by the Road to Zero vision is *Prioritize Safety* which includes adoption of Safe Systems principles and consequent realization of a Safety Culture. The idea of Traffic Safety Culture had been discussed previously in the Toward Zero Deaths Strategy, described as the set of social values, beliefs, and attitudes concerning safety, combined with perceptions of group norms and of the degree of individual control available to affect safety outcomes. The focus on Traffic Safety Culture in the widely-endorsed Toward Zero Death Strategy could be seen as a measure of its broad acceptance among US safety constituents at the time of its release in 2015.

The concept of Safe Systems did not receive comparable widespread US endorsement until the formulation of the Road to Zero vision was completed in 2018. In the Road to Zero vision, the Safe Systems approach is presented as a complement to the Toward Zero Deaths Strategy rather than as a new set of tools or interventions to improve road safety. In the context of the overall vision, Safe Systems is positioned as a means for extending the value of conventional practices by applying them in strategic and systemic ways. Future scenarios in the Road to Zero vision depict several applications of Safe Systems principles, including how cities systematically design roads to accommodate human error, for example by replacing signalized intersections with roundabouts that prevent deadly high-speed side-impact crashes that occur when a driver mistakenly runs through a signal. Others show how crash energy levels have been lowered to accommodate human injury tolerance by narrowing streets in certain locations, slowing traffic so that a collision with a vulnerable road user is unlikely to result in a death. Additional scenarios describe how automatic emergency braking prevents a crash resulting from a combination of driver and pedestrian error and how impairment detection technology prevents a drunk driver from operating their vehicle. All of these examples of Safe Systems principles use practices included among the recommendations of the Toward Zero Death National Strategy.

The third horizon of change described in the Road to Zero vision is *Accelerating Advanced Technology*. Our current road system places very high demand on driver vigilance to avoid crashes, and lapses in road user performance result in frequent crashes. Automation of vehicle control functions that have conventionally been the responsibility of the driver has tremendous potential for reducing these crashes and associated injuries. While a few of these automated functions, such as Electronic Stability Control, Automatic Emergency Braking and Lane Keeping Assist are already in some new vehicles, decades will pass before natural market forces bring such technology to the cars driven by the highest risk drivers, such as those who are most likely to drive after drinking alcohol. Yet more time will pass before the market will permeate the fleet with fully-automated vehicles. The Road to Zero vision stresses the need to supplement market forces with incentives, subsidies and regulations that could accelerate this technology deployment trend along with its safety benefits.

## Expansion of Vision Zero Cities

Following the adoption of Vison Zero by New York City and San Francisco in 2014, additional cities developed and implemented similar programs. As of April 2020, there were 43 communities in the USA with public Vision Zero commitments, mostly at the city level and several at the regional or county levels, as indicated in Fig. 2 (Vision Zero Network 2020). While it is true that most of the early adopters of Vision Zero in the USA were large cities, such as Seattle, Washington; Boston, Massachusetts; and Washington, D.C., there is an increasing number of smaller- and mid-sized communities, as well as suburban communities, making Vision Zero commitments. Rural communities have expressed interest, but have yet to move in significant numbers to make public commitments to Vision Zero.

Notably, the 43 US communities that have adopted Vision Zero planning and implementation efforts as of 2020 are independently and locally led. While their work is influenced by state and federal activities, their core work is largely separate from other governmental levels, except where specific changes are needed, such as seeking authority from the state to make changes in local speed limits.

### Differences Between Local-Level Vision Zero & State-Level Toward Zero Deaths Efforts

In general, city-led Vision Zero efforts have developed differently than state-level zero-based approaches, such as Toward Zero Deaths programs. For instance, most of

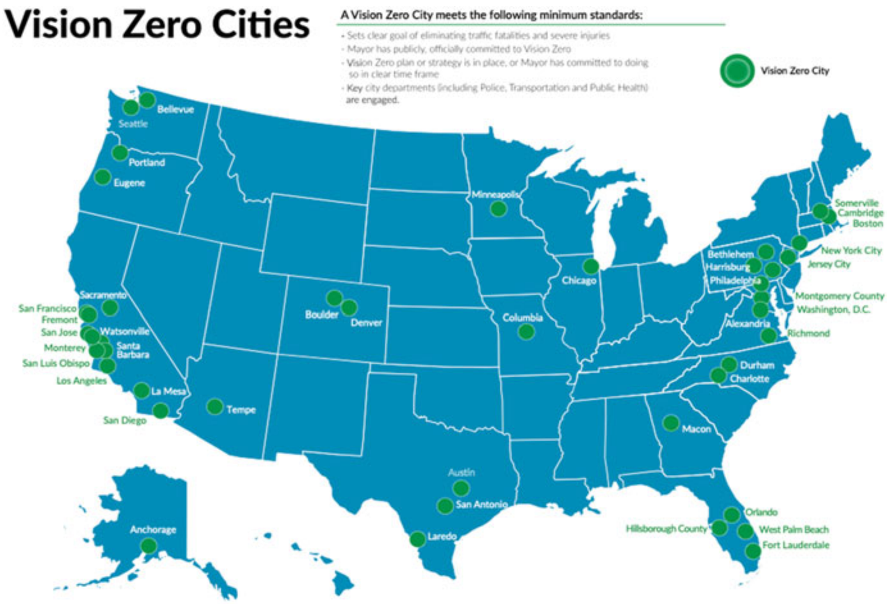


**Fig. 2** US Vision Zero cities in 2020. (Source: Vision Zero Network)

the 43 Vision Zero cities set a target year for reaching zero traffic deaths and severe injuries, generally in the range of 10–15 years into the future. They develop plans based on those targets with clear, actionable strategies that can be measured over time. This has not been a widespread practice at the state level, where broader "zero deaths" language is often used in their federally required state highway safety plans. While there are exceptions such as the State of Washington, State governments have not typically linked funding priorities or policy changes to zero goals, or proposed explicit, public-facing timelines for actions and results.

Another difference is that local Vision Zero efforts have been more likely to engage non-traditional safety partners, building a strong base for change. For instance, Vision Zero cities are increasingly engaging local public health departments in traffic safety work, along with school district leaders and community members, especially those representing groups most impacted by traffic injury and death, such as seniors and communities of color and low-income residents.

In addition, many Vision Zero cities are using a data-driven approach to elevate issues of equity within traffic safety planning and practices. Research shows that people of color and low-income communities are more likely to be negatively impacted by traffic conditions, as are children and seniors, as well as people walking and bicycling. Many local Vision Zero efforts are analyzing these data to inform efforts to address disparities in communities when it comes to safe mobility. This equity-driven approach has, so far, been less prominent at the state level.

Local-level Vision Zero efforts and state-level Toward Zero Deaths programs are generally similar in their lack of explicit link to the Safe Systems approach.

Recognizing this disconnect and the potential benefits of more fully integrating in Safe Systems principles, some national organizations have focused on improving understanding of these principles among transportation professionals and facilitating their adoption through planning and implementation. These groups range from nonprofits, such as the Vision Zero Network, and professional organizations such as the Institute of Transportation Engineers (ITE), to governmental agencies, such as the Federal Highway Administration and the National Highway Traffic Safety Administration.

## Promoting and Facilitating Further Safe Systems Adoption in the U.S.

### Vision Zero Network

While Vision Zero cities (and regions) generally operate independently, a significant amount of information-sharing and peer-influence takes place among them. This is supported in part by the Vision Zero Network (VZN), a nonprofit started in 2015, with the goal of advancing Vision Zero in the US VZN connects these communities with a forum for sharing plans and experiences, and provides leadership and resources, including an emphasis on the Safe Systems approach as the basis of Vision Zero. VZN encourages partnerships between transportation officials and public health, law enforcement, and policymaking professionals, as well as community advocates. VZN conducts regular calls, meetings and webinars to share information, and produces resources to boost Vision Zero understanding, adoption, and implementation. Priorities of VZN include focusing on speed management strategies, elevating equity in Vision Zero and measuring the benefits of Vision Zero actions for broader adoption and effectiveness.

Vison Zero cities in the USA are evolving to fit local needs and conditions, and their level of commitment to the principles of Safe Systems varies. While the Vison Zero Network encourages this diversity of program design and focus, it also works with local program leaders to achieve greater convergence around Safe Systems principles and implementation.

### Safe Systems Work Group

Following the introduction of the Road to Zero Vision, leadership from the roadway engineering profession took steps to build upon the endorsement of the Safe Systems concept. The ITE established a standing Safe Systems work group to advance acceptance and adoption in the USA. The initial objectives of the work group are to:

1. Develop a Safe Systems definition/principles
2. Identify core Safe Systems resources
3. Develop an introductory Safe Systems webinar
4. Develop a Safe Systems Action Plan

Members of the work group represent city, county, state and federal governments, academic institutions, and urban development and vulnerable road user advocates. Recognizing the extent of institutional change necessary for widespread US adoption, the work group deliberated on definitions and principles for Safe Systems that would be consistent with international thought and practice while being appropriate and feasible in the US context. Starting with the contemporary global definition as articulated by the World Resources Institute (Welle et al. 2018) and others, the work group adjusted emphasis and arrived at a practical definition that focused on two key principles:

- A Safe System is designed to *anticipate human error.*
- A Safe System is designed to *accommodate human injury tolerance*.

These two principles were viewed by the work group as a viable starting place that could stimulate change, show benefit, and establish a framework that might later be developed toward the more complete contemporary global definition (Institute of Transportation Engineers 2019). Further points of explanation were provided that touched on the comprehensive system approach and on the idea of shared responsibility:

- A Safe System seeks safety through aggressive use of *vehicle, roadway, and operational changes* rather than relying solely on behavioral changes.
- A Safe System *does not absolve the user of responsibility for safe behavior*, *but neither does it absolve the system owner or operator of responsibility for safe design or maintenance*.

The work group established a web resource for Safe Systems technical literature (Institute of Transportation Engineers 2019a) including fact sheets addressing the new framework along with a number of important Safe Systems references.

An educational webinar was developed and presented by the workgroup in November 2019, drawing nearly 300 participants. The learning objectives of the Introduction to Safe Systems Webinar were to:

- Introduce Safe Systems as an approach in the U.S.
- Recognize the foundation and elements of a Safe System
- Describe how Safe Systems may apply to roadway owners and operators in the U.S.
- Examine how vehicle design and technology are playing a role in Safe Systems

The webinar featured presentations by three widely-respected road safety opinion leaders, and focused on the role of vehicles and roadways in a Safe System. An introductory discussion reviewed the framework developed by the work group and addressed several anticipated questions from the US audience.

One of these questions concerned trade-offs that might be necessary to achieve a Safe System. Potential concessions in vehicle through-put were identified, with an example of reduced speeds in areas where vulnerable road users are present in order to reduce the probability of serious injury if a pedestrian or cyclist is struck by a car. Other potential concessions in road user freedom of choice were pointed out, such as reduced opportunity to drive under the influence of alcohol when impairment detection devices are implemented. Justifications for such concessions were offered, including the moral imperative to maximize safety and the need for a transportation system that accommodates all road users rather than prioritizing those in motor vehicles.

Another anticipated question concerned the pathway for achieving a Safe System. How could such a radical change be made in the US transportation system? The presenters offered an approach that would accomplish change through many small decisions. That is, if system owners and operators would consider the full range of options when making each decision about system design and function during their routine work, and choose the option that is best aligned with the Safe Systems framework, change would accumulate and system wide transformation could occur over time.

A third question was addressed concerning the relevance of conventional safety interventions in a Safe System. Presenters explained that many familiar interventions would be used in a Safe System. Some commonly used interventions, such as rumble strips and Electronic Stability Control systems, are completely consistent with Safe Systems principles because their function is to compensate for driver error. Others, such as lane markings and intersection treatments, may be used differently in a Safe System with the objective of separating vulnerable road users from vehicle traffic to reduce opportunities for error, or to slow traffic in high-risk areas to reduce the probability of serious injury if a collision occurs. Presenters stressed that system owners and operators need to be open-minded about new techniques in order to facilitate a successful transition to a Safe System.

The Safe Systems Work Group designed and administered a survey in September 2019 to gauge knowledge and attitudes about Safe Systems among safety professionals in the USA. The survey instrument was sent to about 500 Road to Zero Coalition members who, in a prior survey, had expressed interest in the section of the Road to Zero vision that addresses Safe Systems and Safety Culture. Responses were received from 88 individuals.

- More than 80% of respondents report being somewhat or very familiar with Safe Systems. This proportion is likely to overestimate knowledge of Safe Systems among all US road safety professionals since the sample frame consisted of individuals who had expressed interest in the Safe Systems portion of the Road to Zero vision.
- Of those working for a public agency, just 11% indicated that Safe Systems was widely practiced in their jurisdiction. Fourteen percent reported that their agency used Safe Systems on a targeted basis, and 35% indicated that their agency sometimes practiced Safe Systems.
- About 85% report that the biggest obstacle to Safe Systems implementation is either knowledge, funding, or leadership. Lack of knowledge was the most frequently reported obstacle at 34%, despite the fact that lack of training was reported by just 10%.


**Fig. 3** Safe System concept diagram. (Source: Institute of Transportation Engineers)

One interpretation of these findings is that the lack of interest by public agency leadership, as reported by respondents, may be discouraging technical professionals from taking advantage of available training resources and preventing further investment of public funds in Safe Systems solutions.

To provide further clarity and direction for Safe Systems development, the Safe Systems Working Group developed a concept diagram and is formulating an action plan. The concept diagram presented in Fig. 3 illustrates the central role of Safe System principles, depicts the use of familiar elements of safety programs, *Safe Roads*, *Safe Speeds*, *Safe Road Users*, *Safe Vehicles* and *Post-Crash Care*, as means for implementing these principles, and shows how these activities define and reflect the ambient Safety Culture.

The pending action plan being developed by the Safe System Working Group will provide additional detail on activities that can be pursued in a 5-year time frame to increase awareness and build support for Safe Systems, develop and disseminate resources and tools for implementation, and institutionalize Safe Systems principles in the practices of road safety professionals.

## Safe Systems Academic Center

Concurrent with the development of the Road to Zero Vision, the US Department of Transportation established a University Transportation Center at the University of North Carolina with the purpose of advancing transportation safety through a multidisciplinary systems-based approach. Working with four other universities, the

Collaborative Sciences Center for Road Safety (CSCRS) is conducting research and developing guidance that combines the principles of Safe Systems with the discipline of systems science.

The CSCRS was established in 2016 with a 6-year project period. The Collaboration has generated a range of research and educational products, including an important report on implementing Safe Systems in the USA (Dumbaugh et al. 2019), and an analysis of Vision Zero plans developed by cities across the USA (Collaborative Sciences Center for Road Safety 2020a). The CSCRS convened a Safe Systems Summit in April 2019 that was attended by more than 340 safety professionals from 29 states (Collaborative Sciences Center for Road Safety 2020b).

## Federal Leadership and Support

The US Constitution preserves broad authority for state governments, including the design and construction of roads and regulation of road users. Vehicle regulation is among the powers given to the federal government since variations among state requirements for vehicle design or performance would be inefficient for vehicle production and hamper both interstate and international commerce. Decentralization of road authority has many advantages with regard to meeting local needs across states that vary significantly in terrain, climate and population. However, this lack of central road authority also has implications for achieving widespread change of the scale necessary for nationwide adoption of the Safe Systems approach.

A federal-aid highway program provides funding each year to states for construction, maintenance and improvement of certain roads and for safety programs targeting road design and road user behavior. Under this program, funds are available for specific purposes and with prescribed eligibility and spending constraints designed to encourage state investment in evidence-based methods.

For 2019, the federal-aid highway program provided more than $40 billion to states (Congressional Research Service 2019). Although these funds do not make up the largest share of road construction and maintenance costs, the program is nonetheless influential in establishing and reinforcing roadway design, maintenance and safety priorities. Investment areas, methods or specific interventions that are emphasized in the federal-aid program are seen as federal priorities or endorsements reflecting the will of the nation's highest-level transportation policymakers, thus influencing state activities.

The federal-aid highway program is revised or renewed on a 6-year cycle as part of the Congressional authorization of the functions and powers of the US Department of Transportation. As the end of a cycle approaches, Congressional offices formulate plans for the upcoming authorization period, and organizations with interests in roadway funding often make recommendations to these offices regarding emphasis areas consistent with their particular needs.

Authorization of the federal-aid highway program is a key opportunity to endorse the Safe Systems approach in the USA. As of 2020, this federal program has yet to address the concept of Safe Systems or provide an incentive for state or local roadway agencies to invest in this direction. Beyond explicit endorsement of the approach, Congressional authorization of the federal-aid highway could also facilitate Safe Systems implementation by incentivizing speed management activities at the state and local levels and removing the specific prohibition against spending program resources on automated traffic enforcement systems. This prohibition discourages adoption of automated speed enforcement, a strategy that has been an important element of Safe Systems implementation in other countries.

### Focus on Children

With support from the FIA Foundation and others, the National Center for Safe Routes to School at the Highway Safety Research Center at the University of North Carolina is promoting adoption of Vision Zero for Youth programs both in the USA and internationally (National Center for Safe Routes to School 2020). These programs are designed first for the benefit of child and youth safety, with a focus on pedestrian and bicycle safety near schools, and have a secondary benefit of introducing Vision Zero and Safe Systems principles to communities. Child-focused safety activities are often easier to start than other road safety programs and frequently develop into larger community-wide efforts (National Center for Safe Routes to School 2013). Vision Zero for Youth programs often begin with a walking assessment following routes that children use to walk or bicycle to school. School officials, city officials and parents are engaged in identifying safety problems and applying Safe Systems principles to reduce risk.

## New Approach: New Expectations

There are challenges to developing and implementing the Safe Systems approach in the U.S., particularly involving community expectations and political leadership, as well as openness to change. Because Safe Systems implementation tends to involve changes to the design of roadways, policies and vehicles, significant change can be slower than with behavioral interventions such as law enforcement programs. While the benefits of a Safe Systems approach are likely greater and more sustainable in terms of lives saved, compared to compliance-based programs, its implementation is slower and results are cumulative rather than sudden.

Political leadership is key to effective implementation of Safe Systems, both by committing the public funds necessary for improvements to roads and by gaining public support for policy and design changes, such as lower speed limits. Support from political leaders can also help gain acceptance for unfamiliar road features such traffic calming, roundabouts, and design changes, such as road diets, which reduce motor vehicle travel lanes to better accommodate space for walking, biking, and transit.

However, political leadership also brings certain challenges. For instance, the Vision Zero, or Safe Systems, approach is not a quick-fix but rather a long-term investment in change. This means that it is likely that a political champion may not see benefits during her or his leadership tenure and could even see negative trends in road safety resulting from a host of other factors (possibly out of their control), making it a riskier political calculation. Also, a close public association between a Vision Zero program and a specific political leader who champions the cause may lessen the subsequent leader's desire to visibly associate with it, as they may want to show their own priorities or brand.

US experience with Safe Systems implementation differs from that of Sweden and other nations in that the movement has been led largely from the local and advocacy levels, as well as by national professional organizations, and less so by the national government. This grassroots approach is perhaps less efficient than strong national leadership in securing resources and direction for local implementation. But considering political realities and the size of the nation and its federal structure, the US strategy of relying on the support of many local leaders may provide more stability in the long term.

Achieving widespread implementation of Safe System techniques in the USA will require a concentrated effort to raise awareness of the potential value of these practices at both the political and practitioner level across the many jurisdictions with responsibility for planning, operating and maintaining the US roadway system. Identifying pathways to implementation for urban, suburban and rural areas will be necessary to illustrate how the Safe System concepts can be adopted in a variety of settings. Tools, case studies and evaluations will help Safe System practices be deployed and support the concept of accomplishing change through many small decisions. The Road to Zero Coalition and its members, with support from the USDOT, can play an important continuing role in supporting the advancement of Safe Systems and movement toward the ultimate goal of Vision Zero.

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# Establishing Vision Zero in New York City: The Story of a Pioneer

# 18

Ann-Catrin Kristianssen

## Contents



**Abstract**

Vision Zero was established in 2014 as the foundation of the New York City road safety policy. The purpose of this chapter is to understand why and how Vision Zero was introduced as well as by whom and with what tools. The chapter focuses on understanding this policy change in New York City and is based on a document study and 18 semi-structured interview with 19 respondents city

A.-C. Kristianssen (✉)
School of Humanities, Education and Social Sciences, Örebro University, Örebro, Sweden
e-mail: ann-catrin.kristianssen@oru.se



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administration staff, researchers, media, and NGOs. The analysis is made by looking closer at the state of four aspects by the time of the establishment of Vision Zero – problem framing, policy formulation, political actors, and proposed solutions. This theoretical framework is mainly based on the work of John Kingdon (Agenda, Alternatives, and Public Policies. Little, Brown, Boston, 1984) and Michael Howlett (Public Policy Adm 34(4):405–430, 2019). The chapter states that there were several factors leading to the adoption of Vision Zero. First, the road safety problems were not as serious as in many other regions of the USA, but compared to other major cities in the western world, the fatalities and serious injuries in New York City were deemed unacceptable by politicians, NGOs, and the public. The imminent problem on the ground was further emphasized by several high-profile cases of child fatalities in traffic crashes. Second, the Vision Zero policy or philosophy was a coherent and above all a successfully tested policy based on a scientific foundation. The credit for introducing Vision Zero in the New York City context is given to non-governmental organizations such as Transportation Alternatives and Families for Safe Streets and specific public administrators in key positions. These actors were all searching for new solutions, and as the politicians placed road safety high on the agenda, a window of opportunity was opened to Vision Zero. In addition, politicians, with the support and pressure from NGOs, established a policy program based on Vision Zero, and this program further established a belief in Vision Zero as a credible way forward. There was and is criticism directed towards the policy based on equity and that Vision Zero risks strengthening discriminatory structures. The basic idea of adapting the physical infrastructure to accommodate human mistakes is challenging in many American contexts, but in a diverse city such as New York, this approach may be able to address equity, according to several respondents, if based on solid crash data. The Vision Zero in New York City differs from the original Swedish version in mainly two ways: the focus in New York on law enforcement and on the behavior of the individual road user.

**Keywords**

Vision Zero · Road safety policy · Policy change · Problem formulation · Policy formulation · Program formulation

## Introduction

> I do think that it was through our advocacy work that Vision Zero was brought to New York. (NGO 2)

> It really was their advocacy that brought the urgency to this issue. [. . .] they came together and said enough is enough, so I think it has come from this urgency of wanting to change and then for New York, it really was just good timing. (NGO 3)

> Mayor Bloomberg and his Transportation Commissioner Janette Sadik-Khan they had really laid a lot of the groundwork for pedestrian and bike projects that would become key parts of Vision Zero. (City Administration 1)

In 2014, New York City adopted Vision Zero as a foundation for its road safety policies. The purpose of this chapter is to describe and analyze this policy change. Vision Zero, as shown in this handbook, is both a road safety philosophy and a policy program. When a philosophy or a policy program like Vision Zero diffuses from context to context, translations inevitably take place to fit the political, administrative, cultural, and infrastructural preconditions. Therefore, we can expect both unique and similar features in the New York City Vision Zero when compared to other Vision Zero programs. It is easy to assume that a policy change is made because the previous policies were bad or even absent, but the New York City Vision Zero was not introduced in a vacuum, as there were plenty of road safety initiatives and measures prior to the introduction. Various city departments worked according to specific road safety strategies in the city, but these measures had not delivered the safety that New Yorkers wanted. Besides recognizing the problem and identifying a possible policy, it is necessary to have the support of as many actors as possible in order to achieve change. This support can also provide legitimacy and resources. One way to gather support for a policy change is to set up a reliable policy program focusing on structures of implementation. Theories of social science show that a window of opportunity for policy change is opened when several factors align such as (1) an urgent problem discussed in broad layers of the society, (2) the emergence of a new policy addressing that problem seemingly better than the old solutions, (3) a political will and support, and (4) the development of a policy program showing convincing paths to success.

These aspects can also be referred to as process streams. John Kingdon (1984) presented his multiple streams framework (MSF) in his study on agenda setting in the USA, and the framework has been a frequent tool to study policy change. In his model, the problem stream, policy stream, and political stream must converge for change to happen. For instance, if you do not have political will, you will not have change. If you do not present a convincing solution, there will be no change and so on. The model was built on previous research (c.f. Cohen et al. 1972) and has since been modified by many researchers by adding, for example, an implementation or program stream (Howlett 2019). The analysis of the road safety policy change in New York City in this chapter is based on a model adding this fourth stream, the program stream, as there is often a need for a credible program of implementation in order to open the window of opportunity.

The overall purpose of this chapter is therefore to describe and analyze the development of Vision Zero in New York City by using a streams perspective. The following research questions are applied:

- What road safety problems are to be solved through the adoption of Vision Zero?
- What is the main content of Vision Zero in New York?

- What did the political process look like, and who were the political entrepreneurs contributing to the adoption of Vision Zero?
- With what program will the Vision Zero policy be implemented?

In addition, these empirical issues will be briefly compared to the Swedish original vision as well as discussing what can be learnt from the establishment process of the New York City Vision Zero. After this introduction, the chapter contains a theoretical discussion focusing on policy change and a multiple streams approach, and thereafter the New York City Vision Zero policy is analyzed by applying these streams. The chapter proceeds with conclusions and a discussion.

## Policy Change

Changes in policies, political priorities, and organizational structures are common and a natural part of societal development. Some of these changes are smaller adjustments to already existing policies, while other changes are more profound and require both a longer period of implementation and more resources, as well as additional personnel. Some changes are made due to external shocks such as disasters or other serious events (c.f Birkland 1997), and other changes occur without too much notice. When making policy changes in areas where you find particularly complicated issues, so-called wicked problems (Rittel and Webber 1973), the changes are sometimes inevitable but also multifaceted. It would not be wrong to refer to the number of people killed or seriously injured in traffic crashes each year as a wicked problem in terms of the complexity of the systems involved. That includes the difficulties of assessing how and when to reach the goal of solving the problem. But, at the same time, road safety initiatives all over the world aim to create a more systematic approach to the problem, to make it solvable. Related to this discussion, Vision Zero provides a new problem description, solutions directly related to the problem, and a vision on how to reach the stated goal (Belin et al. 2012; Kristianssen et al. 2018).

### Levels of Policy Change

Policy changes are generally pursued to solve specific problems, and as problems differ, there are also different forms of policy change. Studies on policy change have focused on everything from incremental changes (Lindblom 1959) to more profound paradigm shifts (Kuhn 1962; Hall 1993), which has resulted in the identification of various taxonomies or levels of policy change. One commonly used description is based on four levels of change (Durant and Diehl 1989; Howlett and Cashore 2009). The first and second levels relate to incremental changes in “ordinary” policy development. One example of a first-level change is an adjustment in existing policies such as tax levels. A second level of change can be the introduction of a new policy for an old problem, for instance, a new policy for addressing problems of segregation without changing the overall problem frame. The third and fourth levels of change focus on more structural or paradigmatic shifts but in different forms and speed. An example of a third-level change is a policy changing the direction of climate change policy and movement towards sustainability. A fourth level change is a paradigm shift, for instance, a completely new economic system. The diffusion of Vision Zero all over the world is described by some researchers and practitioners as a paradigm shift (Belin et al. 2012, Swedish Transport Administration 2018) because it is more or less a complete overhaul of traditional road safety measures and has the potential to lead to a decisively novel outcome. Based on what we already know about Vision Zero and its implementation in various contexts, it is more than an incremental change as it is directly aimed to change the way road safety policy and measures are perceived. Time will tell if Vision Zero constitutes a complete paradigm shift on all levels.

## Multiple Streams

There are naturally many ways to study policy change, and the purpose of this chapter is not to make a full recount of all theories. The temporal focus of this chapter is on the Vision Zero adoption process in New York City. Who promoted Vision Zero, how was it presented, who brought it on to the agenda, and how was it received by both administrative personnel and the public? These questions raised in the chapter relate to Harold Lasswell's (1958) influential model of communication "Who (says) What (to) Whom (in) What Channel (with) What Effect." This model has been influential not only with regard to how policy processes are studied but also in relation to research on agenda setting. As the chapter is based on the adoption process, a focus on multiple streams can provide a fruitful framework for studying this policy change. The streams approach concerns how an agenda is set, the factors leading to changing the agenda, and the actors providing support and leadership. John Kingdon's well-known study from 1984 on agenda setting in the US federal system treated the three streams – problem, policy, and politics – as separate but at the same time interrelated channels. Kingdon's model was inspired, for instance, by the work of Cohen et al. (1972, 1979) who presented what has come to be known as the garbage can perspective. Their model is a break from rationalist models on decision-making, pointing to different flows where there is no way to know exactly how a process will perform. Cohen, March, and Olsen described four flows: problem, solution, participants, and choice opportunities. The model portrays the number of problems, solutions, and participants involved in everyday public decision-making but also that they are only connected when a certain choice opportunity arises. In Kingdon's model, the three streams are also seen as separate arenas, and this highlights the role of policy entrepreneurs connecting the streams. When the streams align, we find a window of opportunity where change can happen quite rapidly. This is a way to explain why, out of an abundance of existing problems and solutions, only some problems and a specific set of solutions end up on the agenda.

Kingdon's streams related to policy change and agenda setting have been used by many scholars through the years and further discussed and developed particularly in the last couple of years (c.f. Cairney and Zahariadis 2017; Howlett 2019). One of these discussions has focused on the gaps in the streams model and the role of implementing specific solutions. According to Michael Howlett, a program stream based on implementation adds new potential to the streams model and will provide an opportunity in this chapter to separate policy design from a policy program perspective.

In this chapter, a four streams model, adding a program stream to the Kingdon model, will thus be used to analyze the empirical material. There are two main reasons for this adjustment. First, Vision Zero as a policy and road safety philosophy is connected both to solutions and to a broader policy program. Without a program perspective, there is risk of losing sight of one possibly important aspect of why Vision Zero became an acceptable policy solution. Having a clear program of implementation could enhance the chances of adoption. Second, the program stream adds other actors, particularly actors within the public administration, to the analysis of why and where a policy change takes place.

### The Problem Stream

In Kingdon's study there are several routes for a problem to reach the agenda, and it is not necessarily the most urgent problem that ends of up being prioritized. The potential for a problem to reach the agenda depends on the support and will of both actors with influence and citizens who experience the problem. A problem can arise as mentioned earlier due to serious events, but it can also be related to earlier known problems that many people can relate to. Whether a problem gets attention is often determined by the existence of convincing narratives that speak to emotions and sometimes the existence of prejudice (Kingdon 1984). Using the words of Carol Lee Bacchi (2009), it is a question of what the problem is represented to be. But a problem given plenty of attention does not necessarily stay in focus, leaving the window of opportunity open for a very short period. In the streams theory, a problem is more likely to receive attention if the problem is related to a convincing policy.

### The Policy Stream

This stream in Kingdon's framework is based on solutions that solve specific problems, and there are often differences in opinion as to what solution is the best, among people with varying expertise, professional viewpoints, or political points of view. Another key aspect is that solutions are developed over time, often in lengthy processes of discussion, translation, transformation, and compromise. A policy thus needs multiple types of support and is ultimately evaluated based on its cost-effectiveness; its technical qualities; its acceptance among politicians, the public, and experts; and of course its ability to solve the problem. The question is how the sometimes fast-moving problem stream connects to the slower policy stream. According to Kingdon (1984), policy entrepreneurs play a crucial role in preparing and perfecting the policy to match the problem. Research on policy entrepreneurs has been further developed by many scholars (c.f. Mintrom and Norman 2009). In this chapter, the focus of the policy stream will be on policy formulation with policy solutions being dealt with in the program stream.

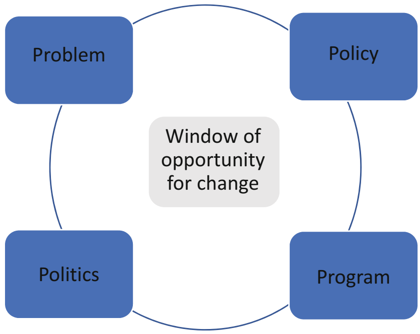


**Fig. 1** A revised multiple stream framework

### The Political Stream

This stream focuses on the phase where ideas are turned into political opinion and where policymakers turn policy options and solutions into actual policies and legal frameworks. This is where political maneuvering takes place, and for a problem to be addressed at a certain point in time, there must be a political will. Sometimes this process coincides with elections which may enhance the chances for certain problems to end up on the agenda (Cairney and Jones 2016). Sometimes this process is predicable, such as in the case of a big crisis, but it could also be related to other factors. Politicians can also actively collaborate with other actors such as NGOs in order to push for a certain idea, problem, or solution, forming so-called advocacy coalitions (Sabatier and Weible 2007). At times competing coalitions arise leading to political conflicts in relation to various policy choices.

### The Program Stream

The earlier mentioned modification of the multiple streams framework (MSF) focuses on adding an implementation or program perspective to the stream. Implementation is more commonly included as one of the policy stages in theories used to study the policy process. The program stream includes actors involved in the implementation process, such as civil servants and administrative officials, as they "...apply their knowledge, experience, expertise and values to shaping the launch and evolution of programs implementing policy decisions" (Howlett 2019, p. 420). Other actors can be active in this stream, such as private entrepreneurs and NGOs, through different form of co-production and collaboration. This stream will not be used in this chapter as a process perspective, but rather to study how the policy program of Vision Zero was presented by the time of the adoption of the vision (Fig. 1).

## Research Design

This chapter focuses on the process of establishing the Vision Zero policy in New York City. It is part of a larger project also targeting policy process perspectives and equity issues. The purpose of the larger project is to map the development of Vision Zero in the city from a historical, political, and administrative perspective. All these topics do not fit into one single chapter, hence the focus on policy change and mainly the period of the adoption of the vision. This chapter more specifically focuses on the main events leading up the adoption of the vision and the actors involved in this process as well as the policy and organizational developments in the immediate period after the adoption. This means that historical developments concerning road safety as well as current developments of the Vision Zero program are mentioned, but not included in a systematic analysis. One specific purpose has also been to briefly compare the Vision Zero program in New York City to other Vision Zero programs adopted in other contexts, such as the original Swedish version.

The chapter is based primarily on a content analysis studying policy documents related to Vision Zero in New York City using the theoretical framework as a sorting mechanism. The documents selected for the study are action plans, guidelines, reports, statements, and newspaper articles, and they represent the period when Vision Zero was established. This qualitative content analysis shows how the problem is framed, the contents of the Vision Zero policy, and what actors play key roles in the adoption process, as well as the proposed program in relation to the vision. Documents from the New York City administration and particularly the lead agency Department of Transportation (DOT) are selected for analysis, and documents from the NGO Transportation Alternatives have been particularly targeted as this organization is identified as the key and leading NGO in relation to road safety.

To fully grasp the role of various actors in the process of promoting Vision Zero and finally adopting this policy, an interview study has been performed. The purpose of the interview study is to add layers and explanations to the process of introducing Vision Zero. In 2019–2020, 18 semi-structured interviews were performed with 19 respondents. The respondents belong to four main categories working with road safety issues in different ways: (1) local public servants representing several departments within the New York City administration that play a key role in the development and work with Vision Zero, (2) representatives from various non-governmental organizations (NGOs) both in the city and on the national level, (3) researchers, and (4) media. The views of politicians have been included in the form of public statements, interviews in the media, and other announcements. The interviews have been transcribed word by word and analyzed using the same theoretical framework but as stated with a particular focus on the process of introducing and establishing Vision Zero. The respondents are anonymous in the study and will be referred to as City Administration 1, 2, 3, etc.; NGO 1, 2, 3, etc.; Researcher 1, 2, 3, etc.; and Media 1, 2, 3, etc.

The questions focused on road safety work prior to Vision Zero; key actors in the process of promoting and establishing Vision Zero; policy documents and legal frameworks; the content of NYC Vision Zero; reactions from the public, administration, and politics; implementation process; organizational structure: Vision Zero task force; concrete measures; and challenges and opportunities.

This chapter is also designed to use the Swedish Vision Zero policy in a comparative perspective in order to describe the similarities and differences in the structure and content of the policy. A full description of the Swedish Vision Zero can be found earlier in this handbook.

## Vision Zero in New York City

As many chapters in this handbook have shown, road traffic injuries and deaths are a global public health problem, and the statistics in the USA display a worrisome trend with a growing number of casualties, particularly among vulnerable road users such as pedestrians (US Department of Transport 2020). In 2018, there were 16 fatalities per 100,000 licensed drivers in the USA leaving 34,654 people dead. The typical fatality is a male motorist in the age group of 25–34 (NHTSA FARS database, accessed March 7, 2021). There are many actors who recognize the problem and work towards finding solutions, but the federal system imposes a number of challenges for the introduction of new policies on all societal levels, new legislation, and other types of innovations, such as vehicle improvement. Vision Zero and safe system approaches are fairly new policy directions for road safety in the USA, but the ambition to work with this approach has been introduced on the federal level, particularly through the Road to Zero strategy from 2014 and the successive campaign (National Safety Council 2014, 2021; NHTSA 2021; Vision Zero Network 2017; see also chapter on safe system in the USA for a comprehensive description and analysis).

Over 40 US states have joined the Road to Zero campaign (Vision Zero Network 2017) together with a large number of coalition partners on the local, state, and federal level (National Safety Council 2021, NSC, list of coalition partners, accessed March 12, 2021). There is a growing interest among states to discuss and incorporate the Vision Zero approach particularly as there is a Vision Zero movement also on the city level. The State of Washington pioneered the Vision Zero approach in the USA, launching their "Target Zero" in 2000, a decade prior to the adoption of Vision Zero in New York City. On the Washington State Department of Transportation website, we can read a well-known argument: "We have to ask ourselves: How many deaths and serious injuries are 'acceptable' on Washington's roadways? How many of your family members would it be 'acceptable' to lose to traffic crashes each year? Ten? Five? Of course, the answer is none. Zero" (Washington State Department of Transportation 2021). The state of Minnesota was another early adopter as it introduced its Towards Zero Deaths program in 2003, focusing on a data-driven approach to road safety work (Minnesota Towards Zero Deaths website 2021).

There has also been a growing diffusion of Vision Zero on a city level, where New York City led the way in 2014, followed by San Francisco the same year. There was a flow of cities adopting Vision Zero in 2015 such as San Antonio, Fort Lauderdale, and Austin. Since then, more cities have followed at a rapid pace (see Vision Zero Network for updated map of Vision Zero communities; see also Gonzalez 2018; Reynolds and Gale 2016; Shahum 2016; Territo 2016). This process has also inspired cities around the world to consider introducing Vision Zero. When looking closer at the development of Vision Zero in New York City, it is important to remember that although it is part of a national policy diffusion process, it is also a big city, larger than smaller countries, at least in population, and therefore it is also a unique city. It is comparable to other large cities in a global high-income perspective but also an inspiration for road safety measures in large cities all over the world.

## The Road Safety Problem in New York City

New York City was and is considered one of the safest bigger cities in the USA when it comes to road traffic safety (DOT 2010), and there were existing road safety measures well before the introduction of Vision Zero – most notably the ambitious goal set in 2008 to reduce the number of traffic fatalities in the city by half by the year 2030. Even though road safety measures had been in place prior to Michael Bloomberg becoming the Mayor in 2002, the Bloomberg Administration that lasted until 2013 is credited with placing road safety high on the agenda.

> And it wasn't until Mayor Bloomberg started really focusing on sustainability and developing PlaNYC, the long-term sustainability plan which was released in 2007 that things started to change dramatically. [. . .] His innovation as a Mayor was the data-driven governance. (NGO 5)

PlaNYC was a strategic plan launched in 2007 to promote a broad agenda for a sustainable New York City (New York City 2007). It has been updated regularly and includes specific policies for road safety, particularly regarding pedestrians and bicycles. The Mayor brought Janette Sadik-Khan in as the Commissioner of the New York City Department of Transport (DOT) where she remained until 2013. She is credited by the respondents as the one who made innovative changes within the DOT and introduced a new perspective concerning urban design and engineering. Another groundbreaking plan was the New York City Pedestrian Safety Study and Action Plan (2010). The Department of Transportation is, together with City Hall, the central actor in the establishment and implementation of road safety policies in New York City, limited by the jurisdiction of the state and federal level which we will return to later on in the chapter. For a more detailed account of the departments within New York City administration and DOT working with road safety, see the following comparative report from The Swedish Transport Administration (2018). These are just examples of the many initiatives taken during the Bloomberg Administration with regard to road safety. So if a progressive road safety policy was already on the agenda, what was the problem that was going to be solved by introducing Vision Zero?

According to the non-governmental organization Transportation Alternatives, the road safety problem in New York City should not be compared to the situation in other US cities, but rather to other large cities in high-income countries, such as Paris or London (Transportation Alternatives 2011). When doing that, New York City falls short, and the organization points to several specific problems. First, the many fatalities are a huge cost for the society particularly since the crashes are preventable. At the time of the introduction of Vision Zero, the overall problem was that too many people died or were seriously injured in traffic crashes, and the first Vision Zero Action Plan described it further:

> . . .approximately 4,000 New Yorkers are seriously injured and more than 250 are killed each year in traffic crashes. Being struck by a vehicle is the leading cause of injury-related death for children under 14, and the second leading cause for seniors. On average, vehicles seriously injure or kill a New Yorker every 2 hours. (City of New York 2014)

Second, the city streets are not designed to prevent crashes. Third, speeding is a major problem, and the poor design does not help. Fourth, there is a widespread "culture of acceptance" when it comes to the number of deaths but also to behavior in the road traffic system. Fifth, the city organization working with road safety was not considered sufficient before the introduction of Vision Zero. Sixth, the same was said about law enforcement, particularly targeting speeding. Seventh, another problem was distracted drivers and driving under the influence of various substances. Eight, all the problems above tend to disproportionally affect vulnerable road users (Transportation Alternatives 2011).

These and many more specific problems are mentioned and discussed in the first Vision Zero Action Plan from 2014. In the foreword, Mayor Bill de Blasio calls for change:

> Drunk driving and failure to use seatbelts, once commonplace, are now socially unacceptable. Today, we must bring the same concerted effort against dangerous and careless driving on our streets. Better designs and regulations are already making our streets safer, and we will expand these efforts. We will bring more resources to enforcement and public outreach. In Albany, we will seek control over the City's speed limits and use of enforcement cameras. (NYC 2014)

The first road safety action plan from the new political administration under Bill de Blasio came in 2014 and, like the following action plans in the Vision Zero program, focused largely on upcoming measures and solutions. The document is a pledge to act, building on years of road safety work. The action plan is based on data provided by the Department of Transportation, and one key conclusion is that "dangerous drivers choices" (NYC 2014, p. 14) is a major cause of traffic crashes. There is furthermore a focus on problems with both physical and automated enforcement as well as insufficient legislation. Unsafe vehicles, both private and public, are also a problem, and the city administration also recognizes the need for improving street design.

If briefly comparing the problem descriptions at the time of the establishment of Vision Zero to the wording today, the problems are described using more or less the same language. Families for Safe Streets, which is a not-for-profit organization based on the engagement of relatives of people who have lost loved ones in traffic crashes, points to road safety problems such as reckless driving, problems of holding these reckless drivers accountable, and failure to construct safe streets (Families for Safe Streets website 2020). Their sister organization, Transportation Alternatives, recognizes the progress made based on the decrease in the number of fatalities from 2013 but argues that the city administration needs a much more holistic approach to the remaining problems and that many key problems are still not addressed (Transportation Alternatives 2018). The latest Vision Zero report from the city administration states that the number of fatalities decreased by 26% from 2013 to 2019 (City of New York 2020). If putting the problem into concrete numbers, in 2014, 259 people were killed in traffic crashes in New York City. In 2016 the number decreased to 231, and in 2018 it was 202 deaths (New York City 2020). In 2020, 244 people lost their lives in the New York City road traffic system (New York City 2021).

One problem that was not included in the overall agenda in 2014 was transportation equity, and this has become a major discussion, especially in relation to the

Black Lives Matter movement. It has become clear that transportation safety is increasingly discussed as a class issue. Several social movements are therefore calling on the city administration to adopt an equity perspective in relation to the transportation system (Transportation Alternatives 2017). The basic problem of inequity concerning road safety can be related also to areas such as environmental justice as some of the largest streets and boulevard with many serious crashes are located in poorer neighborhoods. These arteries have not yet been "engineered" properly which means that people in these neighborhoods have no choice but to use these roads, and, because their design encourages risk-taking and non-compliance with laws, these areas are also targeted by enforcement practices including both speed cameras and patrol interventions.

> This community hasn't received a safety project or a road-diet. So you need to make it safe, so there won't be the need for this inequitable enforcement. So that is kind of the state of it now. We are data-driven, and the data does not consider black, male, female, whatever. It does not always take into account where the infrastructure is. (City Administration 9)

It is also important to see the equity in relation to vulnerable road users. There have been many discussions in the last couple of years about the safety of, for instance, delivery workers (Research 1, 2019).

### Problem Entrepreneurs

For a problem to reach the agenda, there is a need for dedicated actors who constantly remind policymakers and the broader public of a certain problem. Transportation Alternatives is viewed by several respondents in this study as one of the key actors in producing information and creating opinion about traffic safety problems in New York City (Administration 3, 2019). The organization produces reports evaluating the progress of the city administration, holds numerous seminars, and pushes for a more holistic approach to both problem framing and solutions. In addition, organizations such as Families for Safe Streets have worked hard to present the faces behind the statistics. The organization was established in 2014 by families of traffic crash victims. One way to change opinions about problem has been the publication of a list of names of people killed in traffic crashes since 2014:

> Since Mayor Bill de Blasio took office, more than 1,000 vulnerable road users – pedestrians, cyclists, e-bike and e-scooter riders – have been killed on New York City streets. These are their names. This is Mayor de Blasio's legacy. (Families for Safe Streets, https://www.transalt.org/vision-zero-fatalities, accessed December 8, 2020)

These powerful statements are emotional, but the organization has also worked over the years to point to various concrete problems, such as poor street design, drunk-driving, unsafe vehicles, and so on. In addition, the problems were also identified by political actors as well as key administrative units, such as the Department of Transportation, in the years prior to the adoption of Vision Zero. As there were road traffic safety programs in place, there was a consensus between various actors concerning many of the problems. The question at that time was whether road traffic safety would become prioritized in relation to other urgent problems. We know the answer by now, but we will return to a description of this process in the political stream section.

## The Introduction and Development of the Vision Zero Policy

As mentioned earlier, Vision Zero was adopted in areas in the USA as early as 2000, and the policy or philosophy has diffused all over the world to cities, countries, and international organizations. The policy change in New York City was based on a worldwide search performed by NGOs, politicians, and administrators in New York City to find the best practices in relation to road safety. The Swedish Vision Zero has been recognized as a best practice based on its achievements related to the decrease in the number of fatalities and due to the construct of the policy.

> Sweden's Vision Zero – that ultimately no one will die or become seriously injured in traffic – has been recognized by the World Health Organization as a best practice that should be replicated by other cities and countries that wish to achieve ambitious street safety goals. (Transportation Alternatives 2011, p. 39)

Transportation Alternatives, in their report *Vision Zero* from 2011, highlighted the content of the Swedish Vision Zero as a key to progress and ultimate success. They pushed particularly for the ethical foundation of the vision that no one should die or be seriously injured in the traffic system and also that there is no such thing as accidents, as crashes are preventable. This is also part of the Vision Zero presented by the city administration:

> The fundamental message of Vision Zero is that death and injury on city streets is not acceptable, and that we will no longer regard serious crashes as inevitable. (NYC Action Plan, 2014:Foreword)

Another key part of the Vision Zero policy is that the construction of the transport system should be designed to manage the human factor that human beings – no matter how educated they are – will make mistakes. However, this human perspective is not part of the policy description of the city administration at that time. The report from Transportation Alternatives recognizes that this is a basic feature of Vision Zero, but states at the same time that: ". . .individuals often make a deliberate choice to engage in risky behavior on the roads, and too often this choice leads to death and serious injury" (Transportation Alternatives 2011, p. 21). Related to this perspective is the issue of responsibility, which is another key concept in the Swedish Vision Zero policy formulation. Road traffic safety is in Vision Zero a shared responsibility of all actors using the transport system. But the main responsibility ultimately falls on the system designer. This issue seems to be the most problematic to translate into a US context due in part to the notion of individual responsibility as interpreted in the US culture. Relaxing this responsibility is provocative for many US citizens. The description of responsibility follows another logic:

> Those who operate vehicles in a dense and vibrant city like New York have a special responsibility to take care when driving. Reckless or dangerous driving that puts New York families at risk should not be tolerated. In order to crack down on dangerous driving, the City proposes legislation.... (NYC Action Plan 2014, p. 22)

This quote also recognizes the shared responsibility of a broad number of road users, and we need to keep in mind the impact on road safety from the transportation industry such as taxis and other transports. On the other hand, according to the Vision Zero responsibility chain, the ultimate responsibility falls on the system designer. If using a Vision Zero approach, one could say that if it is possible to drive recklessly, it is because the roads are not designed to prevent that and/or that the vehicles are not designed to take human mistakes and errors into account.

The Swedish Vision Zero is based on a scientific foundation both concerning the tolerance of the human body to violence and how that should influence the construction of vehicles, management of speed, etc. and how the development of the policy should be based on good quality data and research. The first perspective is not highlighted in the key documents related to the establishment of the New York Vision Zero. However, it is clear that the policy is based on a data-driven approach. "Data analysis informs every aspect of the City's response to the Vision Zero challenge. The introduction of tools to better identify problematic intersections, corridors and driving behaviors and target resources is essential to success" (NYC Action Plan 2014, p. 16).

One perspective that is prevalent in the city administration's interpretation of Vision Zero is enforcement and the use of both physical and automated enforcement such as speed cameras. Enforcement, as described in road safety terms in the USA, is less related to how safety cameras are used in the Swedish Vision Zero policy. In New York City, they are more related to enforcement than prevention. This is another example of the local preconditions and administrative culture in New York City. According to several of the respondents, New Yorkers demand enforcement and would be very hesitant towards a policy that relied only on infrastructure and vehicle safety (City Administration 5, 2020). Another difference, compared to Sweden, is the aspect of outreach and education. This is not seen as a vital part of Vision Zero in Sweden, but in New York City it is an integral part of the policy. Outreach and communication are key issues in making people understand the notion of shared responsibility.

> Targeted outreach will complement enforcement and street design efforts and will spread the message that traffic deaths are preventable and that New Yorkers are responsible for safe behavior. (City of New York 2014)

If looking ahead to see what has happened to these aspects of Vision Zero, it is clear that the politicians and city administrators are dedicated to the ethical foundation of Vision Zero (NYC Vision Zero 5-year report 2019a). As New York has seen the number of fatalities rising at the end of the 2010 decade, it is also evident that the city administration recognizes the long-term commitment that is required to achieve the goals. As the process has moved along, the notion of shared responsibility can be seen, for example, in the work of the Vision Zero task force and other collaborative efforts which we will return to in the program section. It is important to state that this chapter is not judging what is the best Vision Zero program, but rather to identify differences and point to learning aspects when it comes to interpretations of Vision Zero.

### Policy Entrepreneurs

Vision Zero was promoted by a group of dedicated non-profit organizations, led by Transportation Alternatives, pushing for the adoption of this road safety approach in New York City. They produced reports including Vision Zero policy formulations and suggestions on how to translate the vision into a New York City context. Vision Zero was also consistent with a growing focus on sustainability and a shift away from a car-focused society. Key staff members of the city administration joined in, eventually bringing Vision Zero, with the Swedish version as a role model, to the political table. Politicians, city administrators, and social movements had been looking for best practice models for years, and they found it in the Swedish road safety work.

> We found that Vision Zero had a very well-reputed brand and well-respected brand in policy circles. People knew what it was and believed in it. So we felt like that would be an advantage. (NGO, 5)

One explanation for various actors to come together to work with the same policy could be the circulation of staff, where it is not unusual for people to move from administration to organizations and vice versa. As Vision Zero was adopted, it was translated into a US and an urban context, and the contacts and exchanges with Swedish authorities were constant. This also led to a continued inspiration of specific Swedish Vision Zero policy solutions along the way.

## The Political Process

As we have already concluded, the Vision Zero policy gained support among politicians, and one explanation is that the leading proponent of Vision Zero in New York City, Transportation Alternatives, began promoting and lobbying for change several years before the establishment of the policy. One way to convince the administration of such a change was to frame the city of New York in a global perspective:

> . . .when we compare New York with its peer cities in other developed nations it becomes clear that the city's current goal is not nearly as ambitious as it can and should be. For instance, while New York strives to cut its traffic fatality rate in half in 23 years, Paris did the same thing in just six. New York is already more than three years behind the principal cities of other developed countries. [. . .] This report recommends that New York City become the world leader in street safety and commit to a zero tolerance policy for traffic fatalities, establishing an ultimate goal of completely eliminating traffic deaths and serious injuries. (Transportation Alternatives 2011, p. 42)

It is interesting that the concept zero tolerance is used here as it is in many ways a total opposite to Vision Zero, as zero tolerance tends to be used in relation to enforcement, while Vision Zero is more related to preventability.

Another key to the policy change is that road traffic safety had been prioritized throughout many political administrations in New York City, and this administrative stability is described by the respondents in the study as a key factor in the adoption of Vision Zero (c.f. NGO, 3). From Rudy Giuliani through Michael Bloomberg to Bill de Blasio, the support for road safety measures has been evident. Another aspect of stability is that New York is a solid democratic city (as in the Democratic Party), and one respondent described the city as basically a “one-party city” (City Administration 2, 2020). Even republicans are portrayed as moderate democrats. This political stability is described as one important aspect of paving the way for a policy change related to road safety.

A fourth aspect and possibly the most important factor explaining the political support for Vision Zero is the mayoral election in 2013. In his political platform, mayoral candidate Bill de Blasio vowed to make road safety a prioritized policy area and Vision Zero the road safety policy. After taking office, his administration began working toward the adoption of Vision Zero and an action plan on how to organize and implement the new policy.

Although there was a consensus between organizations promoting Vision Zero, the city administration, and the political leadership, there was and is criticism towards Vision Zero as a policy. We have already touched upon the problems of equity that we will return to briefly in the program description, but there was also criticism from motorist organizations claiming that drivers of motor vehicles were described in unfair terms and that the rhetoric from Vision Zero proponents was offensive.

> We are not opposed to the goal, what we are opposed to is how the goal was enacted. One of the main tenets of Vision Zero is that no matter what, the motorist is always at fault. That is one of our biggest issues. Besides that, it also costs a lot of money. (NGO 4)

The respondents in this study claim that there is also a criticism based on ideology. Vision Zero was and is seen by some actors as a product of liberal European ideas, challenging the choice of the individual.

> There are two kinds of communities that tend to oppose what we are working on, they are either in opposition because they are just a lot more car-oriented than the rest of the city, right? So, in those communities, yes, we will get ideological pushback. And then, the other type of community where we tend to get pushback is more like [. . .] what you are doing is going to change my neighborhood for the worse. [. . .] Just a kind of general conservative idea. (City Administration 2, 2020)

Ultimately, there was a political will to change the road safety policy at that time, the policy had been introduced and marketed as a best practice from NGOs and from within the city administration, the political opposition was weak, and the Vision Zero spoke to interests already in play such as a growing bicycle and pedestrian movement. Although these actors did not necessarily see Vision Zero in the exact same way, it was enough to pave the way for change.

> ...it was a combination of the media getting attention, the advocates mobilizing these victims. How can you look a mother in the face and tell her this is not important when she has lost her son. And then the political situation being ripe with that Mayors race. All of these things came together and that is honestly why I think it caught ground in New York. (NGO 3, 2020)

### Political Entrepreneurs

The political entrepreneurs in this case were a coalition of actors from various NGOs, members of the city administration, and politicians willing to include Vision Zero in their political platforms. Many of the respondents in this study give credit to a few hard-working people at the social movements, and, in their opinion, Vision Zero would have looked different without the input of these key organizations. At the same time, the respondents also point to specific staff members within the administration who quickly saw the potential of Vision Zero and who accumulated more knowledge about the road to zero. These actors all used different tools to convince others of the opportunities of Vision Zero, and these tools consisted of everything from emotional stories from the families of victims to organizational benefits – all taking the city down the road towards zero. It is also worth mentioning that although many of the political, administrative, and advocacy voices aligned in support of Vision Zero, there are still institutions, such as the community boards, who were seen by many of the respondents as almost an obstruction to progress.

> Having to go through each community board and who the community board is comprised of may or may not be representative of the population that is actually living there, which is, you know, often the case. (NGO 2)

## The Vision Zero Program

We will now explore the program perspective of Vision Zero mainly as the plan was presented at the time of the adoption of the vision in the first action plan. When arguing for a new policy and in this case a new goal, you need to convince others that it can be done, and one of the tools for convincing others is a program on how to get there. The program includes solutions in the form of concrete measures; goals, both short and long term; and an organization to manage the implementation.

When Bill De Blasio ran for Mayor in 2013, he promoted Vision Zero as a road safety policy for New York City. His campaign promise was to work according to the ambitious new target to reach zero by 2023 (c.f. Gelinas 2014, 2020), and when taking office de Blasio maintained his support for the vision, although the time frame of the target changed when faced with the challenges of reality. By adopting Vision Zero, new frameworks were introduced regarding both organization and solutions.

Looking first at the organizational changes, the New York City administration had a road safety program in place for many years prior to Vision Zero. That also meant that vital institutions were already in place, which is an advantage when making a policy change and adopting a new program. Several units, such as the Department of Transportation, had been working systematically for years collecting and analyzing data. The DOT is still the lead agency for systematically monitoring road safety and for implementing measures in the streets. One of the main new organizational features presented in the action plan of 2014 was the establishment of a Vision Zero task force.

> The Mayor's Office of Operations will convene and coordinate a permanent Vision Zero task force, comprised of the key agencies and partners needed to implement and extend this plan. The Vision Zero task force will work to meet the goals set forth in this action plan, establish additional benchmarks, and report progress to the Mayor's Office of Operations. (NYC Vision Zero Action Plan 2014, p. 8)

Placing the leadership of the task force at the City Hall is a sign of both political priority and political control. This kind of governance structure relates well to the original Vision Zero perspective of shared responsibility. The composition of the task force, with its 15 members, is based on the involvement and interest in Vision Zero, and its broad representation showed that Vision Zero was expected to permeate many different policy areas. The Vision Zero task force consists of the Business Integrity Commission, City Hall, Department of Transportation, New York Police Department, Department of Citywide Administration Services, Taxi and Limousine Commission, Sheriff's Office, Department of Health and Mental Hygiene, Law Department, District Attorney's Offices, Mayor's Office Community Affairs Unit, Mayor's Office of Data Analytics, Mayor's Office of Operations, MTA, and the Office of Management and Budget (New York City, Vision Zero task force website 2020b). The task force has also developed a number of working groups developing issues further. The task force is described as a key in the Vision Zero program.

> Getting the right people around the table is key. [. . .] They are very committed, they are very passionate, and they are very creative in terms of how they are thinking about traffic safety and how they are working together to come up with you know, ideas that are outside the box. (City Administration 6)

The Vision Zero Action Plan from 2014 furthermore laid out the Vision Zero program, where every department was ascribed a set of more or less detailed solutions. There seemed to be a clear image of what a Vision Zero program should contain, and references are made to some of the pioneers in the world and in the USA. Nonetheless, the program still rests on quite traditional road safety aspects such as the three Es (enforcement, education, and engineering).

> Vision Zero programs combine strong enforcement and better roadway engineering with improved emergency response and high visibility behavior campaigns to discourage dangerous behavior on roads and streets. In addition, Vision Zero-style policies raise the profile of traffic safety problems and help transform cultural attitudes toward traffic death and injury. Rather than accepting traffic fatalities as accidents, Vision Zero allows us – government agencies, industry groups, key transportation stakeholders and the public alike – to understand traffic crashes as the result of a series of actions that can be changed or prevented through enforcement, education, and design. (New York City, Vision Zero Action Plan 2014, p. 9)

The program presented in the action plan concentrated on law enforcement, legislation, street design, city government practices, and dialogue and outreach. The program contained 64 specific measures related to each department working with road safety. It is an ambitious program, and all the measures were to be followed up by the Vision Zero task force (City of New York 2014).

Looking at the recommendations from Transportation Alternatives prior to the adoption of Vision Zero, the solutions and measures suggested are fairly similar to those in the action plan. The focus of the solutions suggested by the Transportation Alternatives is on the ethical aspects of Vision Zero, involving the public in various forms, partnering with the private sector, redesigning streets, speeding, and speed cameras, as well as reaffirming the key role of the Department of Transportation. Another key part of their suggestion for a Vision Zero program was the formation of stakeholder groups and coordination between all relevant city administration units. Transportation Alternatives called for an establishment of:

> a hierarchy of new executive committees and working groups within city government to coordinate street safety initiatives across departments and agencies. These groups should include all city departments that have a stake in eliminating traffic fatalities and injuries. (Transportation Alternatives 2011, p. 41)

What differs is that the measures suggested by the Transportation Alternatives are less focused on the behavior of the road user.

When analyzing how the Vision Zero program is described in more recent years by the city administration, the difference is quite striking. The description of the Vision Zero program is more focused, as many of the earlier measures and reforms are in place. The focus is on collaboration through the Vision Zero task force, data-driven solutions, community outreach, and action plans directed at specific groups of road users (New York City, Year 5 report 2019a).

As mentioned earlier, one significant difference of the New York City Vision Zero as compared to the Swedish Vision Zero is the focus in the program on community outreach, education, and campaigns, although there are shifting opinions also in Sweden about the usefulness of campaigns. It is interesting to note that several of the respondents did not see this perspective as something that will directly correlate with lowering the number of deaths and serious injuries at least not in the short run, but that this kind of measure will hopefully create a common interest and a common safety culture which is important in a long-term perspective.

The current situation in New York has naturally been affected by the Corona pandemic, which has left an unwanted mark on communication patterns and on road traffic safety, as cars are more frequent in the current situation (Transportation Alternatives 2020; Gelinas 2020). The Vision Zero program has not come to a halt, but the respondents interviewed during the pandemic state that the financial situation is problematic and that planned measures will have to wait (City Administration 4 & 5). As the Vision Zero program depends on constant systematic improvements, the road ahead is quite bumpy. In addition, the Vision Zero program has been criticized for not taking equity issues into account, and as social inequality is a major political issue right now, this is a growing discussion in relation to road safety measures (see chapter on criticism of Vision Zero). The city administration has been accused of allowing discriminatory structures of police enforcement to find their way into the Vision Zero policy and of targeting specific groups with manual enforcement through racial profiling. The city administration is also accused of not taking appropriate road safety measures in poorer neighborhoods (Research 1, 2019). The response from the city administration to these concerns is that they are cautious not to reproduce structural discrimination, and that the data-driven approach is neutral in this respect, and lead road safety work to the locations where crashes take place. This creates an opportunity to switch from manual enforcement to automatic enforcement (City Administration 6, 2020).

It is also important to mention that the progress in the Vision Zero policy program is also dependent on good cooperation with the state legislature which controls important statewide policies such as the permissibility of speed cameras. It is also vital to have a good cooperation with the federal government regarding national priorities and norms.

> It is difficult because sometimes we rely on the data that is captured by New York State. And if we do not have access to that or we do not have a representative from the state, that makes our lives a lot more difficult. Policy-wise, speed cameras are very reliant on what legislators pass at the state level and if we do not have that understanding, then basically the whole speed camera program dies. (City Administration 8)

There are of course many more current programs and measures in place that could and should get more attention, but these fall outside the frame of this chapter and will be addressed by the project in other publications. The purpose of this chapter is to summarize the adoption process. To sum up, there are many measures frequently mentioned in both text and in the interviews, and we have already mentioned the safety camera program which is seen as a both cost-efficient measure and a more equitable solution than physical enforcement. The New York City administration has been working intensively with updating the safety of its own fleet (New York City, Citywide Administrative Services 2021) often entailing quite complicated negotiations with the vehicle industry. One respondent used the following example to describe the challenge: "When Volvo sells a truck in England or Sweden it has a sideguard. When they sell that same truck in the United States, the take it off" (City Administration, 4). Other often mentioned measures include prioritized bus lanes especially on major arteries in Manhattan and protected bike lanes.

## Program Entrepreneurs

The Vision Zero program presented by the city administration in its action plan from 2014 shows great similarities with reports and statements from NGOs advocating for the adoption of Vision Zero. Creating a convincing and full program is one way for the city to gather support for Vision Zero. The main actor, working with the first action plan, was City Hall in collaboration with other city departments. The Department of Transportation was and is still a central actor in transforming policy into implementable measures and solutions. The respondents in the study also specifically highlighted the role of the former Transportation Commissioners Janette Sadik-Khan and Polly Trottenberg. The action plan from 2014 was related to the political platform of the new political administration, and looking at the yearly reports from city, it is evident that the Vision Zero program is constantly evolving. Collaboration and coordination among the large number of stakeholders, especially through the Vision Zero task force, have become a key feature. This organizational structure has also been exported to several other Vision Zero cities in the USA. We must not forget the role of NGOs such as Transportation Alternatives, Families for Safe Streets, organizations working with sustainability and research, and others, constantly challenging the city administration to do better as they ask for more Vision Zero, not less.

## Analysis and Conclusions

As New York City already had road safety policies in place at the time of the adoption of Vision Zero in 2014, the question is what kind of policy change did we witness here? Was it an incremental change or something more profound, even paradigmatic? The change from a more traditional view of blaming the reckless driver to focusing more on street design and vehicle safety can be seen as a substantial change, at least in road safety philosophy. At the same time, there is still quite a lot of attention given to the recklessness of individual road users.

### Problem Stream

Analyzing the framing and the construction of the road safety problem in New York City prior to the introduction of Vision Zero, it is evident that no actors found the number of fatalities and seriously injured acceptable. This was further strengthened by the deaths of several children in traffic crashes in conjunction with the period of the mayoral election. There was an opportunity to put the problem onto the agenda by both NGOs, politicians, and private citizens, and particularly by organizations such as Transportation Alternatives, who made sure that the issue was not forgotten. At the same time, there was public awareness of road safety problems, which made it easier to gain acceptance for prioritizing road safety.

### Policy Stream

The Vision Zero policy had been promoted for many years by various NGOs, including bicyclist organizations, organizations working with sustainability, and organizations working towards a car-free society, and as road safety was already on the agenda, there was an opportunity to bring a new policy onto the table. Vision Zero was described as a best practice with an ethical profile matching the description of the problem. As the policy was picked up by politicians, a translation took place to fit into the context. The initial focus on enforcement and drivers' behavior is a deviation from the Swedish Vision Zero but could be interpreted as a way to get acceptance for a shift to a new road safety philosophy. The process of formulating the policy was not connected to conflict, although there were critical voices.

### Political Stream

The mayoral election in 2013 turned out to be a game changer for road traffic safety and an opportunity to promote an urgent problem as well as the solution. In more theoretical terms, the "political mood" was right, and there was an opportunity to make a strong emotional appeal. Being the mayor who would push the numbers down to zero is naturally appealing. In a progressive and liberal city, it did not hurt to partner with strong NGOs with a lot of expertise, not only about road traffic safety but also how to connect road safety to other aspects such as sustainability. To sum up, the political opportunity was there to promote the problem framing and the solution, as well as a broad coalition favoring Vision Zero.

### Program Stream

The final question is whether Vision Zero was also accompanied by a convincing policy program. The Vision Zero Action Plan from 2014 presented a comprehensive program based on shared responsibility. A Vision Zero task force was to be created involving a large number of city administration departments and units. Every department received their list of responsibilities, and the program was more or less guided by the three Es – engineering, education, and enforcement. This rather traditional road safety program was combined with the ethical perspective of zero. The program presented was not aligned completely with suggestions from NGOs, but some of the key aspects, such as collaborative governance structures and redesigning the streets, were similar. The differences in program approach did not cause major disagreements, and perhaps one explanation is that programs can be changed, adapted, and modified as the process advances. We have seen that the program has changed over the years to adjust to new insights and work modes (New York City 2017, 2018, 2019b, 2020a). The question here is whether we needed to add a program stream to understand the policy change. The answer is yes. In order to credibly promote a certain problem framing and a solution to that problem, there is a need for concretization. Inclusion of a program stream in this analysis reveals that the program presented by the city was convincing enough for that window to remain open.

## Discussion

As New York City was considered a quite safe city in a US perspective in terms of traffic crashes, why was it necessary to change its road safety policy? This chapter has concluded that the number of fatalities and seriously injured was not acceptable to any of the actors working with road safety. NGOs focusing on transportation issues provided a platform for emotional stories of grief that had an impact on the view of the problem. Another explanation is that New York City, despite its low number of fatalities in a national perspective, was far behind other similar big cities in the developed world. This was possibly a motivation.

## What Kind of Vision Zero?

Various NGOs and city administrative units had been searching for new methods, programs, and innovative ideas on how to make progress. Vision Zero was promoted mainly by NGOs such as Transportation Alternatives and was backed by considerable knowledge and a policy formulation. The impressive record of the Swedish Vision Zero policy program was used as an argument for change. The Vision Zero policy in New York City was and is not exactly the same as the Swedish version, but was translated to fit the New York context, and there is a growing convergence as well as constant exchange.

> Vision Zero originated in Sweden in the 1990s, and the country remains a model for progress in traffic safety and the administration of Vision Zero initiatives. Over the years, Sweden has evaluated its progress in a way that serves to guide other nations and cities pursuing the goal of zero traffic deaths and serious injuries. (City of New York 2020, p. 22)

Politicians, particularly the Democratic majority, joined with NGOs and administrative units to adopt Vision Zero. The NGOs are today constantly working to promote more road safety measures, and they continue to call for more Vision Zero, not less. But they argue that Vision Zero has to be based on principles of equity, which is a growing concern among many NGOs. The link between the NGOs and the administration is facilitated by a movement of personnel between the two and reinforces mutual understanding.

The New York City Vision Zero policy program, based on a new road safety organizational approach, along with new goal-setting strategies and solutions, adds clarity to how the policy is to be implemented. The structure of the efforts has been praised by many NGOs, but at the same time, the measures are constantly scrutinized and evaluated. For instance, Transportation Alternatives publishes on a regular basis a report card where the key organizations are evaluated based on their performance and on how they work with the Vision Zero program.

## Learning from a Big City Experience

What can we learn from the case of policy change in the New York City road safety program? One apparent aspect is the role of the civil society in promoting new ideas, in creating knowledge and expertise, and persistently holding public authorities accountable. This strategy can lead to both productive collaborations and constant improvements. Another interesting aspect is the construction of a constantly developing collaborative structure within the administration – the Vision Zero task force. Its organization and work modes are undoubtedly something to learn from when aspiring to adopt Vision Zero or other long-term policy commitments. This is one key aspect in the discussions among Vision Zero cities (c.f. Vision Zero Network 2020).

New York City is unique, and the Vision Zero journey of this big city has just begun, particularly in relation to the long-term ambition of reaching zero. This will not be done quickly, and reaching zero by 2023, as was an aspiration in the beginning of the process, is quite impossible. Vision Zero, like other road safety measures, demands patience and can be regarded as a wicked problem in several aspects. Vision Zero also requires a robust system of dedicated actors as well as a comprehensive program. The cultural differences between the various contexts where Vision Zero is adopted are necessary to take into account. The question is whether the New York City Vision Zero will be less effective by focusing more on law enforcement, outreach, and education than the original Swedish version. Time will tell what will be deemed the most efficient ways to work with Vision Zero, and the diffusion process will provide more and more cases to study. Maybe these new cases will provide new ideas and solutions further developing the original policy.

## Cross-References

► Adoption of Safe Systems in the United States
► Arguments Against Vision Zero: A Literature Review

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# Traffic Safety in India and Vision Zero

# 19

Geetam Tiwari and Dinesh Mohan

## Contents



Dinesh Mohan: deceased.

G. Tiwari (✉)
Department of Civil Engineering, Indian Institute of Technology, Delhi, India

D. Mohan
Indian Institute of Technology/Independent Council for Road Safety International, Delhi, India





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**Abstract**

This chapter presents the current state of traffic safety in India and a brief overview of history of traffic safety policies in India. The road safety policy adopted by the Government of India does not have any specific targets; however, the government has accepted the UN sustainable development goals (SDG) and targets in 2016. SDG 3.6 is related to road traffic injuries, and it requires that the fatalities due to road traffic crashes must be reduced by 50% by 2030. The last section of the chapter presents a roadmap for selected cities in India for achieving SDG target 3.6 by 2030 and discusses the results in the context of "Vision Zero" for India.

## Introduction

"Vision Zero" is a landmark safety policy. It was introduced in Sweden at a time when Swedish roads and transport system were considered one of the safest systems in the world. Most countries have traditionally accepted that health losses due to accidents are a major, but to some extent acceptable, consequences of mobility. Contrary to this, the Swedish parliament in October 1997 opined that the long-term target for the road transport system should be that no one should be killed or receive long-term disablement by the system (Claes Tingvall 1998; Claes Tingvall and Haworth 1999). The Vision is an expression of ethical imperative that "It can never be ethically acceptable that people are killed or seriously injured when moving within the road transport system" (Claes Tingvall and Haworth 1999).

Vision Zero demands that the loss of human life in the road transport system is unacceptable, and therefore the transport system should be designed in a way that such events do not occur. This means that safety is a more important issue 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. Prior to the introduction of the Swedish Vision Zero concept, Dr. William Haddon in the USA had proposed that road traffic injuries be considered a serious public health problem and provided a structured method of analyzing and developing targeted interventions for safety (Haddon 1970, 1980). Charles Perrow introduced a structural analysis of complex systems, highlighting the notion of systemic error rather than an individual's error in high-risk systems (Perrow 1984). Vision Zero brought in the "Ethical Imperative" in the traffic safety debate.

That road traffic injuries (RTI) should be considered a public health problem has been accepted for decades (Gibson 1961; Haddon 1963, 1968). In 1962, L.G. Norman, who was the Chief Technical Officer of the London Transport Executive, prepared a report for the WHO in which he stated that "It has even been suggested that the limit of human performance is being reached in this respect and that the consequent accidents are the inevitable price of motorization. This view should not be accepted" and that "As a public health problem, road accidents are amenable to treatment by the methodology applied to epidemic disease, including the detailed investigation of individual incidents and the application of epidemiological techniques" (Norman 1962). However, RTI is the only public health problem where society and decision-makers still accept death and disability on such a large scale as inevitable (Mohan 2003). This human sacrifice is deemed necessary to maintain high levels of mobility and is seen as a necessary "externality" of doing business. Discussion only revolves around the number of deaths and injuries we are willing to accept. This is made clear in the opening paragraph of the US *Highway Safety Manual*: "There is no such thing as absolute safety. There is risk in all highway transportation. A universal objective is to reduce the number and severity of crashes within the limits of available resources, science, and technology, while meeting legislatively mandated priorities" (AASHTO 2010). A complete departure from this mode of thinking is "Vision Zero" that originated in Sweden. In October 1997, the Road Traffic Safety Bill founded on Vision Zero was passed by a large majority in the Swedish parliament (Tingvall1997; ""Vision Zero" in perspective of global generalization," 1998).

This chapter presents the current state of traffic safety in India and the issues surrounding the possibility of moving toward Vision Zero. A brief overview of history of traffic safety policies in India is presented to set the context. The road safety policy adopted by the Government of India (https://morth.nic.in/national-road-safety-policy-1) does not have any specific targets; however, the government has accepted the UN sustainable development goals (SDG) and targets in 2016. (https://niti.gov.in/index.php/verticals/sustainable-dev-goals) SDG 3.6 is related to road traffic injuries.

## National Road Traffic Injury Fatality Rate

According to official statistics, 151,417 persons were killed and 469,418 injured in road traffic crashes in India in 2018 (Transport Research Wing 2019). However, this is probably an underestimate, as not all injuries are reported to the police (Bhalla et al. 2017, Mohan et al. 2009, Gururaj 2006). The actual number of injuries requiring hospital visits may be 2,000,000–3,000,000. In GBD 2010, it was estimated that there were 2.2 million injuries in India that warranted hospital admission, and 18 million injuries warranted an emergency room visit (Bhalla et al. 2014). Road traffic injuries (RTI) in India have been increasing over the past 50 years (Fig. 1). This may be partly due to the increase in the number of vehicles on the road but mainly due to the absence of coordinated evidence-based policy to control the problem. These data show that the number of fatalities has continued to increase at about 70% a year over 2000–2010, a slight lower rate over the past decade.

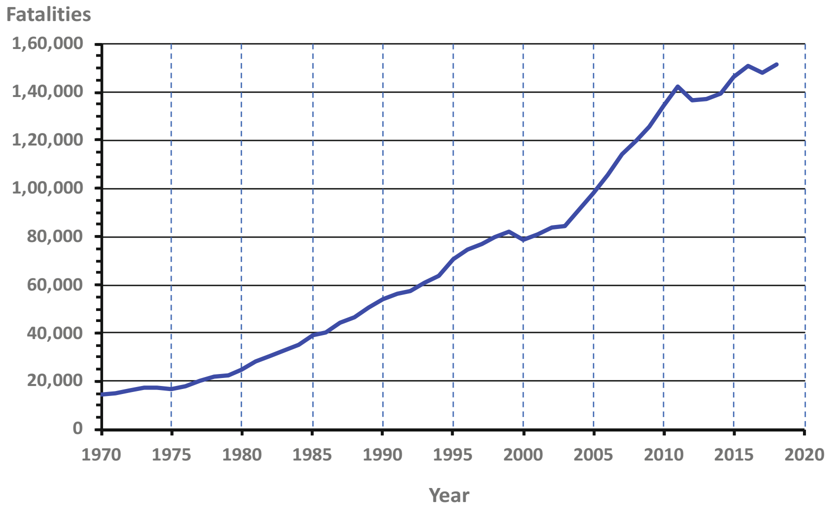



**Fig. 1** Road traffic deaths in India from 1970 through 2018. (Source: NCRB 2015 and Transport Research Wing 2019)

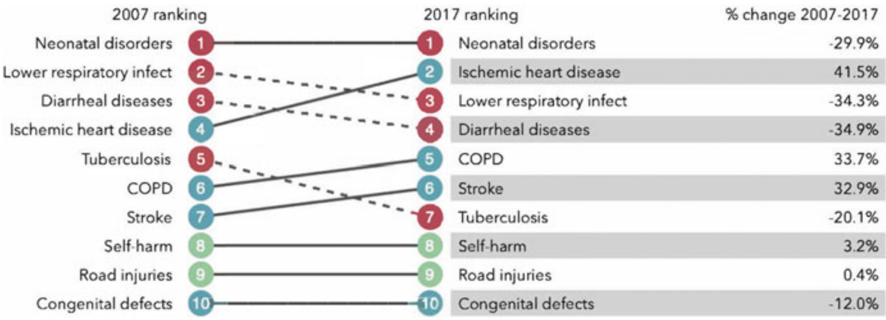



**Fig. 2** Top ten causes of years of life lost (YLLs) in India in 2017 and percent change between 2007 and 2017 for all ages. (Source: Institute for Health Metrics and Evaluation (IHME 2018))

## Ranking in Causes of Death and Population Health

Figure 2 shows the top ten causes of years of life lost (YLLs) in India in 2017 and percent change between 2007 and 2017 for all ages (Institute for Health Metrics and Evaluation (IHME) 2018). This figure shows that injuries resulting from road traffic crashes impose a substantial burden on the health of the population in India. Road traffic injuries are the ninth leading cause of premature death in India, and this exceeds the number of those who succumb to many diseases like malaria and HIV that are acknowledged to be important health issues in the country.

Figure 3 shows that over the last two and a half decades, the burden of road traffic injuries in India has increased, while that due to many infectious diseases has

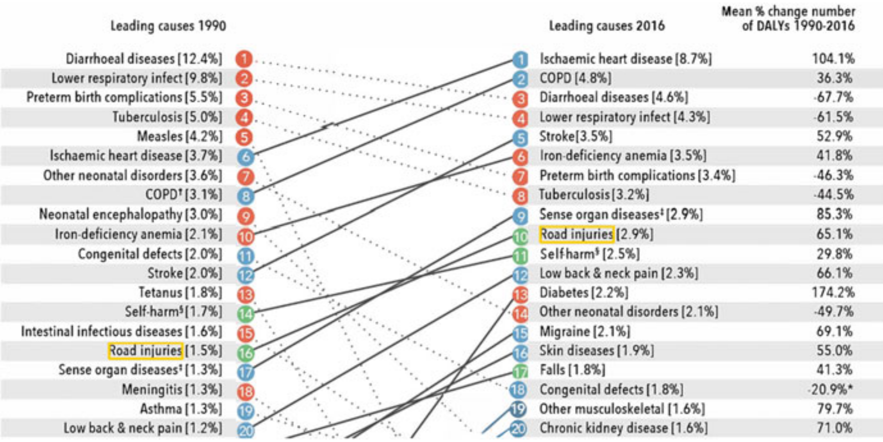



**Fig. 3** Change in DALYs number and rate for the leading individual causes in India from 1990 to 2016. (Source: Indian Council of Medical Research, Public Health Foundation of India, & Institute for Health Metrics and Evaluation (IHME) 2017)

declined. In 1990, road traffic injuries were the 16th leading cause of health loss. However, in 2016 they were ranked tenth due to an increase of 65% in disability adjusted life years (DALYs) attributed to road traffic injuries (Indian Council of Medical Research, Public Health Foundation of India, & Institute for Health Metrics and Evaluation (IHME) 2017).

## International Comparison

The 2018 WHO *Global Status Report on Road Safety* provides two sets of road traffic death statistics for every country (WHO 2018). These are the official government statistics (usually based on police data) reported by each country to the WHO and statistical estimates produced by the WHO by analysis of national health data (including vital registration) for each country. Figure 4 shows the official RTI fatality rates for different countries plotted against per capita income of the countries, and Fig. 5 shows the rates for the same countries as estimated by the WHO (WHO 2018). These figures show that for 43% of the countries, the WHO estimates are 1.5 times greater, and for 26% more than 3 times greater than the official rates are reported by the countries.

The ratio of the WHO estimate and the official rate for different countries is shown in Fig. 6. The ratio for India is 2.0 as the official reported rate is 11.4 deaths per 100,000 persons and the WHO estimate is 22.6. These data indicate that some countries with similar incomes have lower levels of underreporting and some with higher income levels have also have higher levels of underreporting. This suggests that lower national income levels cannot be taken as an excuse for inefficient data collection systems and it is possible for countries like India to set up professionally

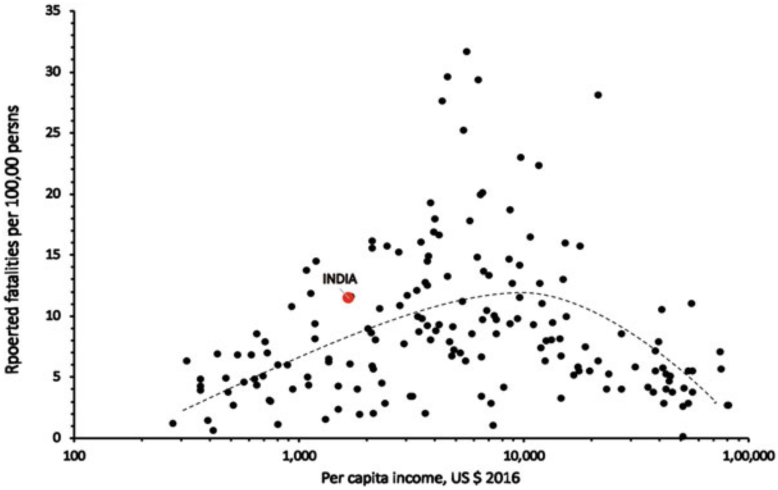



**Fig. 4** RTI fatality rate per 100,000 persons reported by different countries vs per capita income. (Source: WHO 2018)

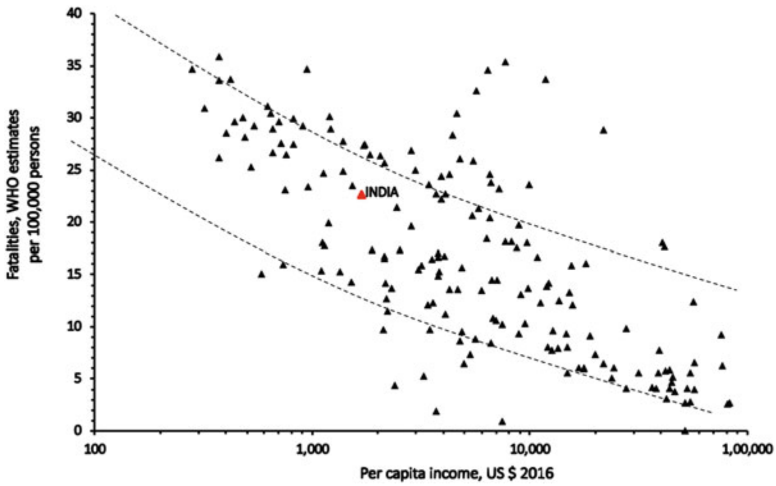



**Fig. 5** RTI fatality rate per 100,000 persons as estimated by WHO for different countries vs per capita income. (Source: WHO 2018)

managed data collection systems that give a reasonably accurate estimate of RTI fatalities. Systematic collection requires streamlining police data at State level, establishing a system like FARS (Fatal Accident Recording System) in the USA.

Both the official country data and the WHO estimates (Figs. 4 and 5) show that there are countries with incomes similar to India that have RTI fatality rates lower than India. Again, demonstrating that lack of finances does not necessarily mean that a society has to have absence of safety on the roads. Of course there are many factors

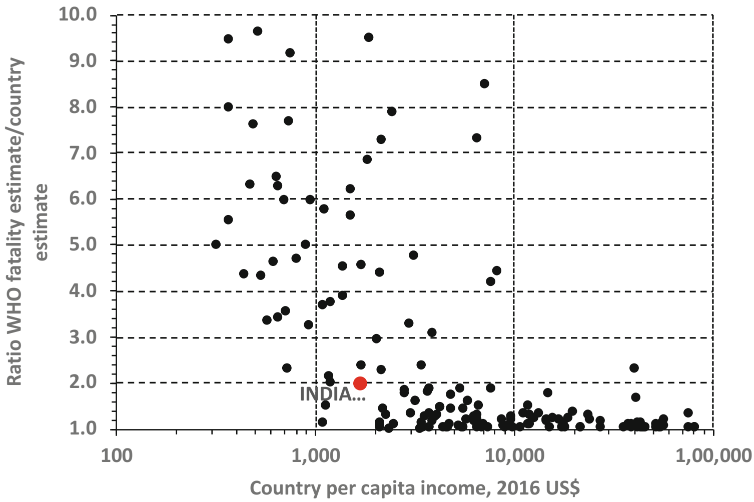



**Fig. 6** Ratio of the WHO estimates and official RTI fatality rate per 100,000 persons for different countries vs per capita income. (Source: WHO 2018)

other than income that affect crash fatality rates. However, income is considered an important factor. At the same time, many countries much richer than India have much higher fatality rates. Therefore, we cannot depend on growth in national income alone to promote road safety. It will be necessary to put in place evidence-based national safety policies to ensure improvements in traffic safety.

## Analysis of Data at the National Level

### National Fatality Rates

Figure 7 shows the official estimates for the total number of RTI fatalities and fatalities per 100,000 persons in India from 1970 to 2018 (Transport Research Wing 2019). The total number of deaths in 2018 was 10 times greater than in 1970 with an average annual compound growth rate (AACGR) of 6%, and the fatality rate in 2018 was 4.3 times greater than in 1970 with an AACGR of 4%. There are indications that the rate of growth of fatalities in India decreased after 2010. There have been a few periods when the absolute growth in RTI fatalities decreased briefly, but the causes for the same are not known. However, it is known that motor vehicle crash rates have a tendency of decreasing along with a downturn in the national economy (International Traffic Safety Data and Analysis Group 2015):

> Economic downturns are associated with less growth in traffic or a decline in traffic volumes. They are associated with a disproportionate reduction in the exposure of high-risk groups in

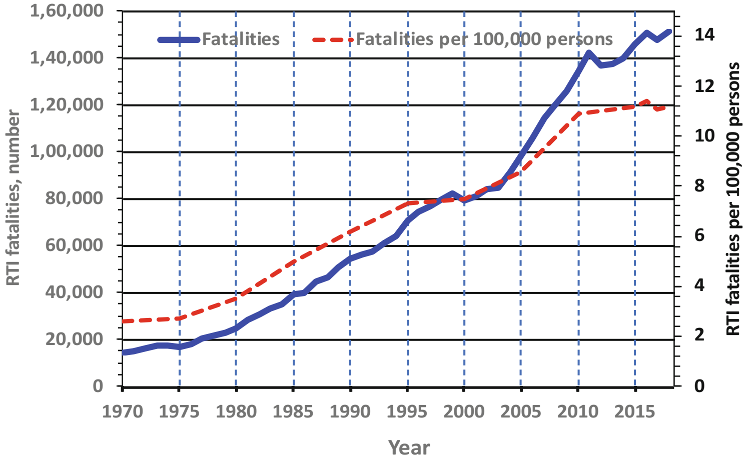



**Fig. 7** Total number of RTI fatalities and fatalities per 100,000 persons in India. (Source: Transport Research Wing 2019)

> traffic; in particular unemployment tends to be higher among young people than people in other age groups. Reductions in disposable income may be associated with more cautious road user behaviour, such as less drinking and driving, lower speed to save fuel, fewer holiday trips.

This may explain the reason why the rate of growth in fatalities slowed down in India in the late 1990s and in the period 2010–2014 as these were also periods of low economic growth. Two modelling exercises have attempted to predict the time period over which we might expect fatality rates to decline in different countries (Koornstra 2007, Kopits and Cropper 2005).

Kopits and Cropper used the past experience of 88 countries to model the dependence of the total number of fatalities on fatality rates per unit vehicle, vehicles per unit population, and per capita income of the society. Thus, based on projections of future income growth, they predicted that fatalities in India will continue to rise until 2042 before reaching a total of about 198,000 deaths and then begin to decline. Koornstra used a cyclically modulated risk decay function model, which in a way incorporates the cyclically varying nature of a society's concerns for safety and predicts an earlier date of 2030 for the start of decline in RTI fatalities in India. If we assume the average growth rate of 6% per year declines to nil by 2030, then we can expect about 200,000 fatalities in 2030 before we see a reduction in fatalities.

The above models use the experience of high-income countries (HIC) over the past decades in calculating relationships between vehicle ownership levels and risk of death per vehicle. Therefore, the models presuppose the onset of decline at specific per capita income levels if the past road safety policies of HICs are followed in the future in countries like India. These predictions are based on the assumption that the relationship between fatality rates and income follows a pattern as shown in Fig. 4. However, if the pattern is more like the one shown in Fig. 5, then these predictions would not be reliable. The relationship between national income and RTI fatality rates (initial increase in deaths with increasing incomes and a subsequent decrease) may not be entirely correct. Therefore, it is possible that the earlier claims that fatality rates will continue to increase until societies reach income levels between US$ 10,000 and 20,000 (2013 international prices) before decreasing are probably not correct.

Based on an analysis of RTI fatality trends in Europe and the USA, Brüde and Elvik (2015) suggest that:

> A country does not at any time have an 'optimal' or 'acceptable' number of traffic fatalities. In countries with a growing number of traffic fatalities, one cannot count on this trend to turn by itself; active policy interventions are needed to turn the trend.

The trend shown in Fig. 4 is often used to justify that RTIs will increase until the per-capita income reaches 10 K USD. Elvik (2015) conclude that active policy interventions are required to turn the trend". If this is true, then the only way the decline of RTI fatalities can be brought forward at time is to institute evidence-based India-specific road safety policies that are more effective.

## Estimates of Modal Share of RTI Fatalities in India

Figure 8 shows estimates of the share of different road user fatalities as reported by MoRTH (Transport Research Wing 2019) and estimates made by Hsiao et al. (2013), the present authors (IIT Delhi estimate), and Dandona et al. (2020). Hsiao et al.'s estimates are based on a nationally representative mortality survey of 1.1 million homes in India which reported 122,000 RTI deaths, IIT Delhi estimate is based on an analysis of police records obtained from 8 cities (Delhi Traffic Police 2014, Mani and Tagat, 2013, Mohan et al. 2013) and a number of locations on rural roads around the country (Gururaj et al. 2014, Tiwari 2015, Tiwari et al. 2000, and Dandona et al.'s (2020) estimate is based on several verbal autopsy data sources.

The MoRTH estimates suggest that pedestrian fatalities constitute only 15% of total RTI fatalities in the country. The Hsiao et al. (2013), IIT Delhi, and Dandona et al. (2020) estimates for share of pedestrian fatalities are 37%, 33%, and 35%, respectively. This is a very large gap between the official and researchers' estimates. Since Hsiao et al. and Dandona et al. have estimated the fatalities from verbal autopsies with a statistically representative sample of households in India (a part of the sample registration system of the Registrar General of India), it is likely that their numbers are closer to the truth. The IIT Delhi estimate is made from detailed analysis of police reports from various parts of the country and, therefore, may be considered as being based on official data, though from a smaller sample in the country. Since these latter estimates for pedestrian fatalities are similar, it is quite certain that these estimates are more reliable than those in MoRTH reports. The error in the official reports probably arises from wrong coding of the victims' status, and the procedure needs to be reviewed carefully and revised. A detailed analysis of

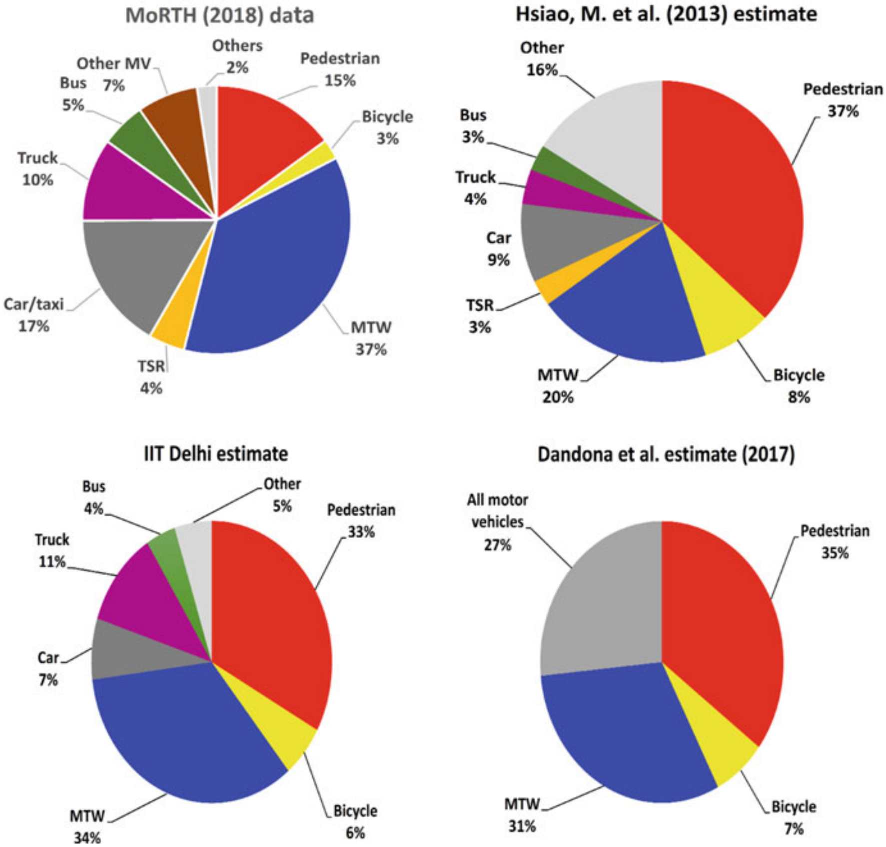



**Fig. 8** Estimates of the share of different road user fatalities in India. Note: MTW, motorized two-wheeler; TSR, three-wheeled scooter ricksha. (Source: Transport Research Wing 2019, Hsiao et al. 2013, GBD: Institute for Health Metrics and Evaluation (IHME), IIT Delhi estimate – authors of the present report)

police records shows that the cases are registered, however, error occurs at the time of coding. Non recording may also be there, however, bigger problem at the moment is wrong coding. The Indian official estimates of pedestrian fatalities are extremely low compared to independent researchers' estimates (~15% vs ~35%); therefore, official estimates for all other modes will also be wrong. MoRTH data is based on police coding. The data is collected from the police station, compiled at State level and then at the National level. We have explained the coding problem of data earlier. IITD data source is also police data, however, coding is done in the lab after reading the description of the crash. The difference in the two data sets point to the erroneous coding. Hsia et al. (2013) and Dandona et al. (2017) is based on a different methodology (oral autopsy of one million deaths in the country). MoRTH is erroneous for coding the victims, when a bigger vehicle is involved. MTW and bus collision in which MTW is the victim may get recorded as bus victim if the bus

**Table 1** Modal share of road traffic fatalities in selected high-income countries. (IRTAD Road Safety Annual Report 2019, https://www.itf-oecd.org/road-safety-annual-report-2019)

| Country | Car | MTW | Bicycle | Pedestrian | Other |
|---|---|---|---|---|---|
| France | 51 | 23 | 5 | 14 | 7 |
| Germany | 48 | 19 | 12 | 15 | 6 |
| Japan | 21 | 16 | 15 | 37 | 11 |
| The Netherlands | 41 | 7 | 30 | 8 | 7 |
| Canada | 50 | 11 | 2 | 18 | 19 |
| Sweden | 56 | 17 | 7 | 10 | 10 |
| USA | 36 | 14 | 2 | 16 | 32[a] |

*MTW* Motorised two-wheeler
[a]Includes SUV, van, pickup truck

has been recorded as vehicle at fault. For the time being, we will have to use research estimates for modal share of road traffic fatalities and not the official number.

The modal share estimates for India are significantly different from those in most high-income countries (Table 1). What is most important to note here is that the proportion of car occupant deaths for countries included in Table 1 (except Japan) is greater than 40% and motorized two-wheelers (MTW) less than 23%. Estimates in Fig. 8 suggest that car and motorized two-wheeler occupant fatality proportions are <10% and >30%, respectively. These proportions in India are unlikely to change dramatically over the next decade. Because of these differences, road safety priorities may have to be very different in India, and some new safety interventions would have to be developed to move toward Vision Zero.

## RTI in Urban Areas

According to the MoRTH report, 51,379 (34%) fatalities took place in urban areas and 100,038 (66%) in rural areas (Transport Research Wing 2019). These data suggest that the urban RTI fatality share is about the same as the estimated urban population share (34%) in 2018. (Rural population (% of total population) – India. The World Bank. https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=IN) The latest report includes details for 50 million-plus (population) cities recording a total of 17,709 fatalities (34% of all urban RTI deaths). Figure 9 shows deaths reported in these cities for 2015 and 2018. Figure 10 shows the RTI death rates per 100,000 population in million-plus cities for 2015 and 2018. Population numbers for these cities are not available for 2015 and 2018 from the Office of the Registrar General and Census Commissioner, India. Population for each city in 2015 and 2018 was estimated using 2011 figures and official growth rates for the states they are located in (Technical Group on Population Projections 2006).

There were 10 cities with 50% lower rates than the average for all cities in 2018 with rates ranging from 2 to 7 fatalities per 100,000 population: Ahmedabad, Amritsar, Hyderabad, Kannur, Kochi, Kolkata, Mumbai, Pune, Srinagar, and Surat. It is not possible to explain the differences in city fatality rates per hundred

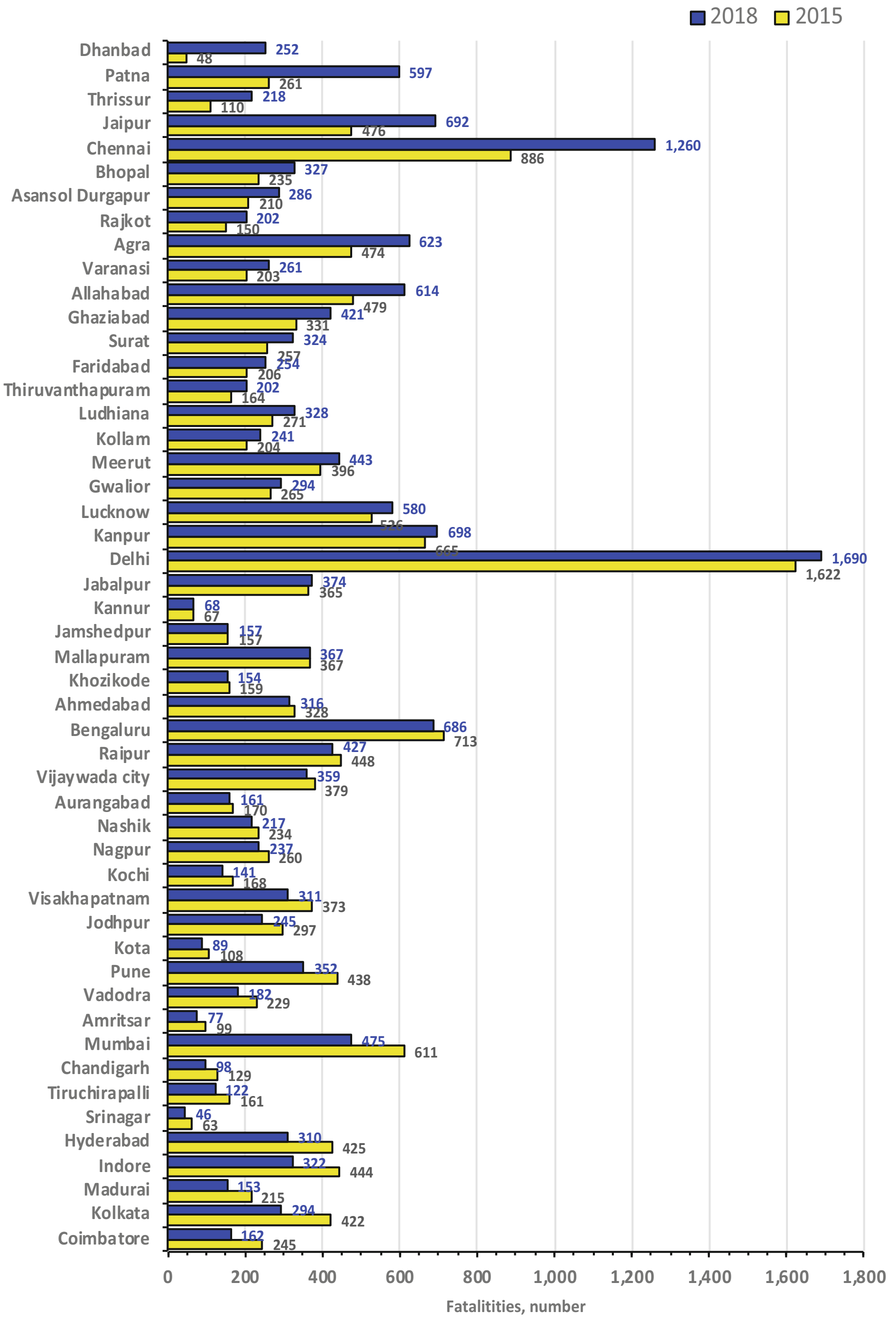



**Fig. 9** Annual RTI deaths in million-plus (population) cities in 2015 and 2018. (Source: Transport Research Wing 2019)

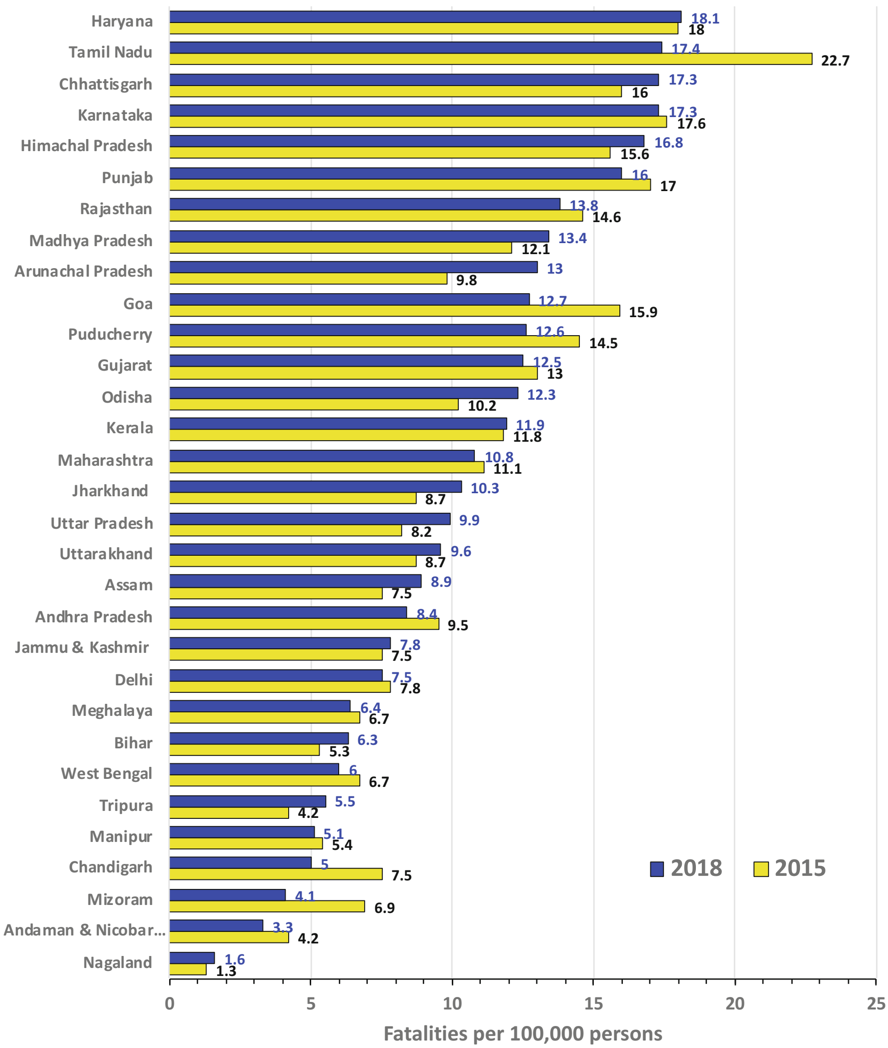



**Fig. 10** RTI deaths per 100,000 persons in million-plus (population) cities in 2015 and 2018. (Source: Transport Research Wing 2019)

thousand persons as we do not have details of the implementation of safety policies in any of these cities. It is interesting to note that none of the high-rate cities include cities with populations greater than three million, whereas the low-rate cities include five with population greater than five million. The low-rate cities have rates that are similar to some of those in high-income countries. It would be important to investigate why rates are so different across cities in the same country. The findings might give us new clues on planning for Vision Zero in India. A study that examined the influence of road type and junction density on road traffic fatality rates in cities in the

USA suggests that a city with a higher proportion of wider roads and large city blocks will tend to have higher traffic fatality rates and therefore in turn require much more efforts in police enforcement and other road safety measures (Mohan et al. 2017a). We need to understand the influence of city form on road traffic crashes to make Vision Zero a reality. Since a vast majority of the victims in the cities are vulnerable road users, one possible cause of low death rates in low-rate cities (populations greater than five million) could be reduction of vehicle speeds due to congestion.

## RTI Details for Selected Cities

Table 2 shows the proportion of road traffic fatalities by road user type in nine Indian cities. These cities vary in population from 280,000 to 20 million. The data for Delhi were obtained from the Delhi Police Department and for all other cities by analyzing First Information Reports (FIR) maintained by the police departments in the respective cities for a period of three years (Mohan, Tiwari, and Mukherjee 2013).

The proportion of vulnerable road user (pedestrians, bicyclists, and motorized two-wheelers) deaths in the nine cities range between 84% and 93%, car occupant fatalities between 2% and 7%, and occupants of three-wheeled scooter taxis (TSTs) less than 5% per cent, except in Vishakhapatnam where the proportion for the latter is 8%. The total of vulnerable road user deaths remains relatively stable across cities of different sizes, and the proportion of pedestrian deaths appears to be higher in cities with larger populations. VRUs are pedestrians, bicyclists and MTW victims. When these columns are added in Table 2, the range is 65–75%. Proportion of pedestrians in Delhi and Mumbai the large cities is higher than other cities.

## RTI Victims and Impacting Vehicles

Figure 11 shows the data for distribution of road traffic fatalities by road user category versus the respective impacting vehicles/objects for two of the nine cities, Vishakhapatnam and Bhopal. These two cities are representative of the patterns in all the cities studied and have been selected as the fatality rates per 100,000 persons are different with Vishakhapatnam at 24 and Bhopal at 14 in 2011. In both cities, the largest proportion of fatalities for all road user categories (especially vulnerable road users) is associated with impacts with buses and trucks and then cars. This is true for the other cities also. The most interesting feature emerging from this analysis is the involvement of MTW as impacting vehicles for pedestrian, bicyclist, and MTW fatalities in the cities. The proportion of pedestrian fatalities associated with MTW impacts ranges from 8% to 25% of the total. The highest proportion was observed in Bhopal. The involvement of MTWs as impacting vehicles in vulnerable road user (VRU) fatalities may be due to the fact that pedestrians and bicyclists do not have adequate facilities on the arterial roads of these cities and that they have to share the road space (the curbside lane) with MTW riders.

**Table 2** Proportion of road traffic fatalities by road user type in nine Indian cities. (Source: see text)

| City | Population | Pedetrian | Bicycle | Motorised two-wheeler | Auto-ricksha | Car & taxi | Buus | Truck | Other |
|---|---|---|---|---|---|---|---|---|---|
| | | **Percent** | | | | | | | |
| **Delhi (2018)** | 1,99,58,118 | 46 | 3 | 34 | – | 4 | 1 | 0 | 12 |
| **Agra (2013–15)** | 15,74,542 | 41 | 10 | 37 | 4 | 2 | 4 | 2 | 0 |
| **Amritsar (2013–15)** | 11,32,761 | 27 | 20 | 40 | 5 | 3 | 1 | 3 | 1 |
| **Bhopal (2013–15)** | 17,95,648 | 41 | 5 | 44 | 3 | 2 | 2 | 3 | 0 |
| **Ludhiana (2013–15)** | 16,13,878 | 35 | 23 | 35 | 3 | 3 | 1 | 0 | 0 |
| **Vadodara (2013–15)** | 16,66,703 | 32 | 12 | 41 | 3 | 4 | 1 | 7 | 0 |
| **Visakhapatnam (2013–15)** | 17,30,320 | 43 | 6 | 35 | 9 | 3 | 1 | 3 | 0 |
| **Patiala (2015–2018)** | 4,80,000 | 22 | 14 | 51 | 3 | 7 | 3 | 0 | 0 |
| **Bulandshahr (2015–2018)** | 2,80,000 | 26 | 7 | 51 | 2 | 5 | 3 | 5 | 2 |

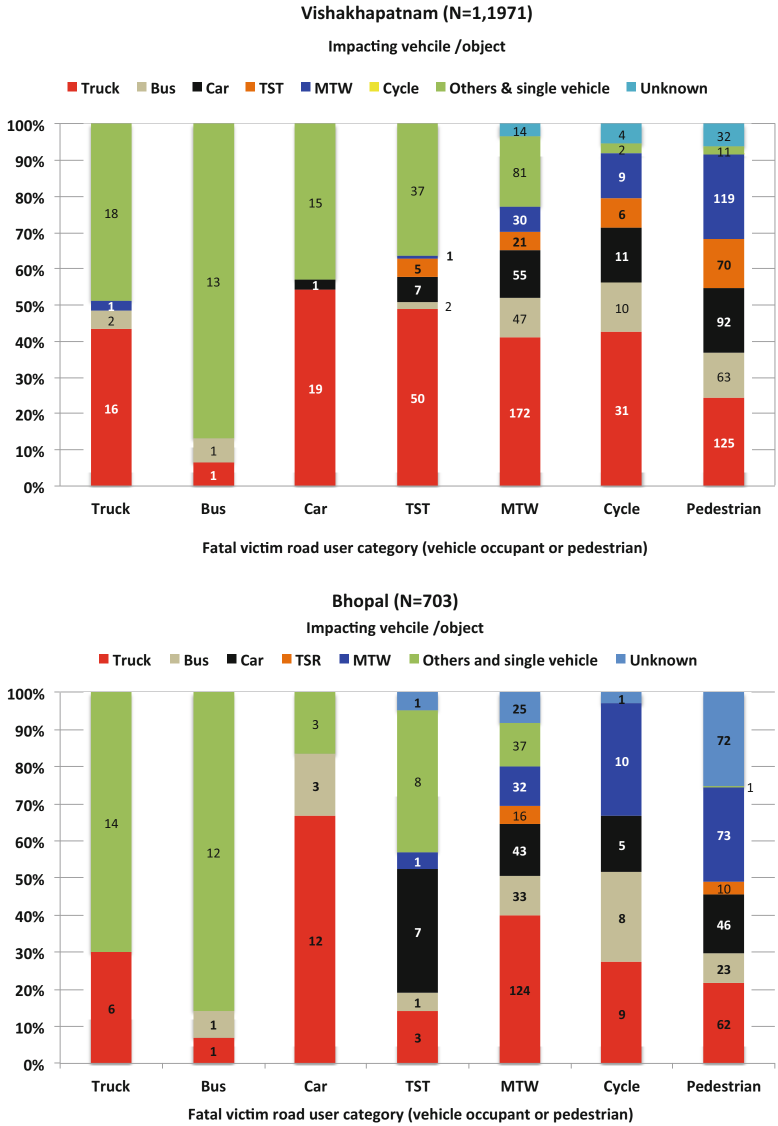



**Fig. 11** Fatal RTI road user category and impacting vehicles/objects in Vishakhapatnam and Bhopal (numbers in bars represent number of cases; TST: three-wheeled scooter taxis)

The issue of serious injuries and fatalities among pedestrians hit by motorcycles has not received much attention internationally. Since the use of motorized two-wheeler for personal transport and deliveries is increasing in a large number of countries, it is necessary to give greater attention to safer motorcycle design and management of their movement on city roads.

## RTI on Intercity Highways

Figure 12 shows the proportion of RTI fatalities on different categories of roads and the proportion of road length for each category (Transport Research Wing 2019). Fatality rate per km of road is the highest on national highways with 47.3 deaths per 100 km annually (Fig. 13). The relatively high death rate on NH could be because they carry a significant proportion of passenger and freight traffic. However, since details of vehicle km travelled on various categories of highways are not available, it is not possible to make a comparison based on exposure rates.

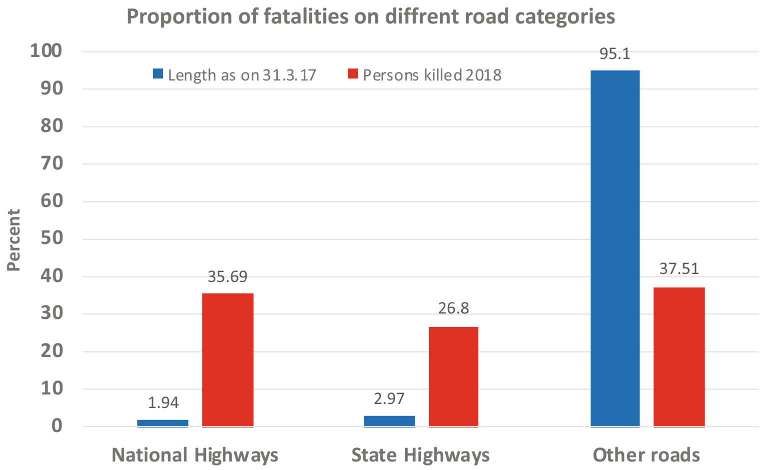



**Fig. 12** The proportion of RTI fatalities on different categories of roads and the proportion of road length for each category. (Source: Transport Research Wing 2019)

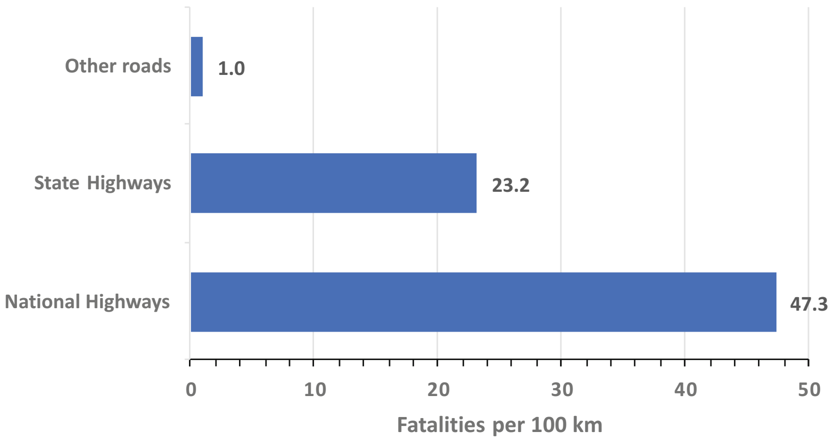



**Fig. 13** Fatalities per 100 km on different categories of roads in India in 2018. (Source: Transport Research Wing 2019)

Recent research studies have reported fatal crash rates (fatalities per km) for three NH (NH-1, NH-8, and NH 2) as 3.08 crashes/km/year on six-lane NH-1, followed by 2.54 crashes/km/year on four-lane NH-24 bypass, and 0.72 crashes/km/year on two-lane NH-8 (Naqvi and Tiwari 2015).

### RTI Patterns on Highways

A detailed study of 35 selected locations on highways showed that pedestrians and bicyclists constituted 43% of the fatalities (Tiwari, Mohan, and Gupta 2000) (Table 3). A more recent study (Tiwari 2015) investigated police reports of fatal crashes on selected locations on two-lane, four-lane, and six-lane highways and showed that the proportions of motor vehicle occupants and vulnerable road users were 32, 19 and 52% and 68% respectively, whereas the proportions for urban areas were 5%–10% vehicle occupants and the rest vulnerable road users. Though the motor vehicle occupant fatalities are higher on highways than in urban areas, as would be expected, the differences are not as high as in Western countries. A majority (68%) of those getting killed on highways in India comprise vulnerable road users, and this fact should be the guiding factor in future design considerations. Data from three highway segments from 2009 to 2013 show a similar pattern. Pedestrian and MTW proportions are very high except on the six-lane highway where the proportion of truck victims is higher.

Table 4 shows the involvement of different impacting vehicles in fatal crashes on highways. This shows that as far as vehicle involvement is concerned, the patterns are similar in urban and rural areas. Trucks and buses are involved in about 70% of fatal crashes in both rural and urban areas. This is again very different from Western countries where there are significant differences in rural and urban crash patterns.

It is possible that these high rates of vulnerable road deaths on rural highways are due to the fact that these roads pass through high-density population areas where local residents who do not possess motorized means of transport have to walk along these roads, cross them, or wait on the shoulders to access public transport. Some major design standards for rural highways and expressways have to be re-examined in the light of these findings.

## Road Safety Policies and Enabling Legislation in India

When cars appeared on the street in the West and elsewhere, traffic engineering was established as a formal scientific and technical discipline. In the mid-nineteenth century, British colonial rulers in India established formal engineering training institutes to assist in the construction of railways, roads, and canals. The focus of this training was to impart knowledge about concrete, surveying, and construction techniques. The textbooks and the teaching resources came from the UK and the English language (Palit 1998). The Indian Roads Congress was established in 1934 to guide Indian engineers how to plan and build roads. The concrete roads were replaced with asphalt roads as was done in Europe, and the control of roads was given to provincial authorities – state public works departments – and local municipalities in some cases. The national trunk roads remained under the central control, and the Central Road Fund was created in 1930 to develop and maintain these roads. (Gijs Mom, India and the Tools of Empire: the emergence of the layeredness of modern mobility) Almost one hundred years later, the Indian Roads Congress continues to be an important professional body today. A large number of road planning and design guidelines have been issued to guide the field engineers involved in rural roads, state highways, and national highways.

The first Motor Vehicles Act in 1939 was introduced with the motivation to control vehicles plying on the road and protect the interests of the state-run railways. The number of cars, buses, and trucks grew from 1918 to 1930; however, there was a sharp decline in the number of cars from 1930 to 1940, and the number of buses and trucks remained constant. Buses were mostly for intercity movement. Buses provided a good option for third-class railway passengers, and cars competed with the first-class railway passengers. In cities three-wheeled "*rickshaw*" was first introduced for goods movement by Chinese traders and quickly spread in most major cites as passenger vehicles. A multilayered complex mobility evolved with the introduction of new technologies. Though there was some substitution of travel modes, it was not in a simple linear pattern which is easily predictable. The Census of India in 1936–1937 shows the dominance of pedestrian traffic followed by rickshaw motor cars and buses, not very different from the mix of traffic present on Indian roads a century later, with the exception of motorized two-wheeler.

While the road planning and construction is guided by various codes and guidelines issued by the Indian Roads Congress, the vehicle movement and vehicle specifications and penalties for violation of MVA rules are guided by the Motor Vehicles Act and Central Motor Vehicles Rules (CMVR). Until the mid-1980s, there was little discussion of traffic safety in these documents. The 1939 Act was primarily concerned about fixing liability based on driver error as "rash and negligent" behavior, enhancing penalties, and creating additional offenses. The existing law and policy debate on road safety in India have continued to focus on these three aspects. The 1987 urban transport plans expressed concern over vehicular pollution and traffic safety. There is also a discussion of planning urban areas in such a way that the need for travel is reduced – self-contained districts. "Efforts have been made to restrict the movement of slow moving vehicles like cycle rickshaws, hand carts and animal-drawn carts on congested roads within the CBD area in many cities. Priority for buses and other passenger vehicles, ban on heavy goods carriers and exclusive pedestrian streets are some of the regulatory measures suggested for the improvement of the traffic conditions in several cities" (Srinivasan, N.S. et al.Urban roads- India Report. in PIRAC World Road Congress, 1987).

Two important developments occurred in the late 1980s. One, the National Highways Authority of India was set up by an act of the Parliament, NHAI Act, 1988: "An Act to provide for the constitution of an Authority for the development, maintenance and management of national highways and for matter connected therewith or incidental thereto." (https://nhai.gov.in/about-nhai.htm) The second important development was the revision of the Motor Vehicles Act of 1939. The Motor Vehicles Act, 1988, came into force from 1 July 1989. It replaced Motor Vehicles Act, 1939, which earlier replaced the first such enactment Motor Vehicles Act, 1914. For exercising the legislative provisions of the Act, the Government of India made the Central Motor Vehicles Rules, 1989.

In 2005, the Ministry of Roads and Highways (MoRTH) that constituted an expert committee on Road Safety and Traffic Management was given two responsibilities (Committee 2007):

1. Study what new laws or amendments to existing laws would be required.
2. Recommend a structure for the proposed Directorate of Road Safety and Traffic Management, and advise on its role and functions.

Some of the key observations of the committee report were:

1. Existing institutions are not equipped to deal with increasing traffic on the roads.
2. Key ministries and the public sector play a peripheral role in improving road safety.
3. Road safety is not a priority in the development agenda of the state and central governments.
4. The existing Road Safety Council does not have adequate statutory backing, budgetary resources, or the mandate to be effective.
5. India must adopt the advancements made globally in road safety techniques and technology.

   The Committee also appended a draft of a law to its report, calling it the National Road Safety and Traffic Management Act. The Bill based on this draft was not accepted by the parliament.

In 2014, the Supreme Court of India established a committee of road safety experts headed by a retired justice of the Supreme Court of India. The committee's mandate is to (1) measure and monitor on behalf of the Supreme Court the implementation of various laws relating to road safety in the states and central ministries and (2) to identify the need for further legislation or changes in the existing laws.

The committee has been directing state governments to report progress made in implementing road safety laws since 2014. The 1988 Act was amended by The Motor Vehicles (Amendment) Act, 2019. The Act provides in detail the legislative provisions regarding licensing of drivers/conductors, registration of motor vehicles, control of motor vehicles through permits, special provisions relating to state transport undertakings, traffic regulation, insurance, liability, offenses and penalties, etc. The amended MVA has several provisions not included earlier: increased compensation for road accident victims, Motor Vehicle Accident fund to provide compulsory insurance cover to all road users, defining a good Samaritan, recall of defective motor vehicles, development of the National Transport Policy and National Road Safety Board, recognizing taxi aggregators, and increased penalties for several offenses.

Out of the many amendments proposed in the Act, increased penalties have been implemented in many states from 1 September 2019, and at the same time many states have decided to "dilute" the suggested increase in penalties. Most of the suggested amendments seem to be based on "common sense" as opposed to scientific evidence and therefore are not likely to have a serious impact on reducing road traffic crashes.

Many road safety concerns have not been addressed by the amended MVA. For example, the presence of villages and small towns along the highways has resulted in a mixed traffic patterns on highways in India. The density of small towns and villages along the highway and the presence of tractors, MTW, and three-wheelers on the highway along with cars, buses, trucks, and truck trailers present a very different traffic mix as compared to North America and Western Europe where most of the highway standards have been developed.

Traffic crash patterns in India are also substantially different as compared to North America and Western Europe. Pedestrian and motorcyclist involvement in fatal crashes on highways is greater than that of other road users. These highway crash patterns are similar to those observed in urban areas. In the past two decades, major investments have gone into expanding the national highway system in India. Yet the number of fatalities has continued to grow. This requires review of the current highway standards prevalent in India. Perhaps field experiments are required to develop appropriate road designs which meet the requirement of mixed traffic as is the practice in many European and North American countries.

Despite the efforts in the last few decades, the number of road traffic fatalities has continued to increase in India. The MoRTH report of 2018 has listed 1,51,430 fatalities. On the other hand, a study based on the sample registration system (verbal autopsies of a national sample) of the Government of India estimated that there were 275,000 road traffic fatalities in India in 2017 (Menon et al. 2019), and another recent modelling estimates 218,876 fatalities in the same year (Dandona et al. 2020). These estimates report higher share of pedestrian and motorized two-wheelers as RTC victims as compared to the MoRTH report. The states with better road infrastructure have higher rates of fatalities (Tamil Nadu, Karnataka, Kerala, Maharashtra, etc.). The MVA amendments do not address the reliability of crash estimates, which forms the basis of designing preventive strategies.

We have not yet created a system of producing scientific evidence for designing preventive strategies in India. A 2007 report from New South Wales in Australia evaluated the effectiveness of stricter penalties and found, "It is suggested that substantial increases in fines and licence disqualifications would have limited potential in deterring recidivist offenders. The present analysis, failed to find any evidence for a significant relationship between fine amount and the likelihood that an offender will return to court for a new driving offense. Nor was there any evidence from our analyses to suggest that longer license disqualification periods reduced the likelihood of an offender reappearing before the courts" (Briscoe 2004), and a meta-analysis suggests that "Increasing traffic fines was found to be associated with small changes in the rate of violations" (Elvik 2016). This suggests that increased fines as suggested in the amended MVA alone will not have the intended effect of reducing traffic crashes. The current traffic safety science suggests that if road users do not take their share of the responsibility, for example, due to a lack of knowledge or competence, or if personal injuries occur or for other reasons that lead to risk, the system designers (road designers) must take further measures to prevent people from being killed or seriously injured. This is consistent with the Vision Zero theory, which suggests that humans have limitations in perception, diligence, and other driving-related performance that are predictable and inevitable. These natural limitations are the primary reason for increased responsibility by system designers.

Therefore, reduction in the growing health burden due to traffic crashes requires establishing a system or institutional structure which enables generation of new knowledge – new road standards to ensure safe highways and urban roads in India, a highway design that can ensure safety of pedestrians, and a roundabout design that can control speeding two-wheelers. The newly amended Motor Vehicles Act provides for a National Road Safety Board to be created by the central government through a notification. The Board will advise the central and state governments on all aspects of road safety and traffic management including (i) standards of motor vehicles, (ii) registration and licensing of vehicles, (iii) standards for road safety, and (iv) promotion of new vehicle technology. The proposed board does not have any statutory powers; this may become another version of the current National Road Safety Council having representation from various ministries and other stakeholders with no statutory powers. The NRSC is expected to meet at least once a year. The presence of NRSC has not had any impact in reducing traffic crashes in the past. In the next section, we present case studies based on current safety knowledge.

## Can Current Safety Knowledge Lead to Vision Zero in India?

In this section we present a scenario analysis for two small cities in India to estimate the effectiveness of implementing specific vehicle- and infrastructure-related strategies. In case of the smaller cities, this gives a unique opportunity since the number of fatalities is less compared to the larger cities in India. In addition to that, setting up countermeasures is easier if integrated early into the system.

### The Approach to Reduction in Road Traffic Fatalities Estimation

In this exercise we attempt to evaluate the effect of the following road safety measures over time in the next 10 years. Three interventions are considered for assessing the impact on traffic safety. These are:

1. Vehicle safety devices with safety technology.
2. Enforcement of existing traffic laws with respect to the following specific aspects:
   (a) Speed control
   (b) Red light running
   (c) Seat belt use

   (d) Helmet use
   (e) Drinking and driving
3. Road infrastructure improvement for speed control.

### Intervention 1: Vehicle Safety Regulations in India

Vehicle safety devices for cars (crashworthiness standards) and motorized two-wheelers (antilock-braking systems (ABS), combined braking systems (CBS), and daytime running lights (DRL)) have shown to reduce fatal crashes. The recent amendments to the Motor Vehicles Act have stipulated these devices along with crashworthiness to be mandatory for cars and MTW.

The Ministry of Road Transport and Highways, Government of India, prescribed that front seats of all motor vehicles must be equipped with lap and shoulder belts which took effect on 1 April 1994. Three-wheelers with engine capacity less than 500 cc were exempted. All vehicles sold in India after this date have been equipped with belts in front seats. Installation of seat belts on all rear seats in cars was mandated in September 2002. The government made crashworthiness norms mandatory for all new models of cars from October 2017 and for existing models from October 2019. The new minimum safety norms, including frontal and side crash tests, apply to all cars, and the cars are tested for offset frontal crash norms at 56 km/h and 50 km/h for the side crash test. In general, these crash test norms cannot be complied without the cars being equipped with airbags for front seat occupants.

The Ministry of Road Transport and Highways mandated that all new MTWs sold after 1 April 2017 be equipped with automatic headlamp on (AHO) feature (similar to the daytime running lamps (DRLs)). Antilock braking systems (ABS) were made mandatory for all new MTWs with engine capacity above 125 cc and combined braking system (CBS) mandatory for those below 125 cc which took effect on 1 April 2018.

The number of vehicles produced after 2019 and the proportion of the same in the fleet in subsequent years will determine the effectiveness in terms of the lives saved due to these devices. Since this intervention does not require any intervention from the city administration, it has been included as the first intervention.

### Intervention 2: Regulations Regarding Use of Seat Belts and Helmets

The Motors Vehicles Act 1988 (India) made use of helmets mandatory for all MTW riders in the whole country in 1988. Use of seat belts by front seat occupants was made mandatory nationally five years later on 18 March 1999. But the use of seat belts by rear seat occupants was mandated by Motor Vehicles Amendment Act 2019. However, since enforcement of traffic regulations is a state subject in the federal structure of the Indian constitution, traffic regulations have to be notified and enforced by each state. The Delhi Traffic Police made use of seat belts by front seat passengers compulsory which took effect on 15 February 2002 and initiated enforcement of the same.

Even though the Motor Vehicles Act is a central government act, the enforcement of the law by the police authorities is in the purview of state and city law enforcement authorities. This has resulted in a paucity of the law being enforced. The use of seat belts and helmets is responsible for a sizeable decrease in fatalities in road traffic crashes. It is very important to note that since airbags are being installed in all cars produced post-2019, not using a seat belt in a car fitted with airbags can at times lead to an increase in injury to the occupants of the car. Enforcement being a local governance matter and something that can be easily achieved has been taken as the second intervention. Enforcement of seat belts and helmets is relatively easy and does not require any additional training or equipment for the traffic police; drinking and driving enforcement from global experience is not as easy. So we have taken the enforcement of alcohol and narcotic use by the driver as the last intervention.

Intervention 3: Reduction of vehicle speeds and preventing interaction between the vulnerable road users (VRUs) and motorized vehicle have shown great improvements in reduction of fatal road crashes. All these require changes in road infrastructure that have been scientifically designed. The main examples of these changes are conversion of junctions to roundabouts and installing speed controlling devices like speed breakers/rumble strips and speed cameras and pedestrian/bicycle centric infrastructure. These require both capital cost and time along with coordination between multiple local government agencies; because of these limitations, this has been taken as the third intervention. An improvement of 7% per year in installation of these infrastructural changes has been considered to achieve the SDG targets. This requires investment by the city governments; therefore, a low limit of 7% has been assumed.

### Methodology of Estimation of Effectiveness of Intervention

The first step was to do a classification of the possible interventions followed by an exhaustive search of the literature to ascertain the effectiveness of the various interventions. Various systematic reviews and meta-analyses published were taken, and for every intervention, the average value of their respective effectiveness was taken for the analysis. Tables 3, 4, and 5 show the assumed effectiveness values and the corresponding sources.

**Table 3** Effectiveness of vehicle safety technologies

| Interventions | Effectiveness | References |
|---|---|---|
| Antilock Braking System (ABS) (MTW) | 10.0% | Seiniger et al. (2012) |
| Antilock Braking System (ABS) (MTW) | 12.5% | Seiniger et al. (2012) |
| Antilock Braking System (ABS) (MTW) | 34.0% | Seiniger et al. (2012) |
| Antilock Braking System (ABS) (MTW) | 37.0% | Seiniger et al. (2012) |
| Antilock Braking System (ABS) | 13.0% | Bhalla et al. (2019) |
| Antilock Braking System (ABS) (car) | 2.8% | Bhalla et al. (2019) |
| Antilock Braking System (ABS) (car + MTW) | 9.6% | Bhalla et al. (2019) |
| Electronic Stability Control (ESC) | 19.4% | Bhalla et al. (2019) |
| Airbags | 3.2% | Bhalla et al. (2019) |
| Front pedestrian protection (car) | 6.0% | Bhalla et al. (2019) |
| Crashworthiness (car) | 28.1% | Bhalla et al. (2019) |

**Table 4** Effectiveness of enforcement

| Interventions | Effectiveness | References |
|---|---|---|
| Seat belts (car) | 12.1% | Bhalla et al. (2019) |
| Helmets (MTW) | 42.0% | Liu et al. (2009) |
| Helmets (MTW) | 37.3% | Peng et al. (2016) |
| Alcohol enforcement | 8.70% | Staton., et al. (2016) |

**Table 5** Effectiveness of road infrastructure changes

| Interventions | Effectiveness | References |
|---|---|---|
| Speed bumps | 59.0% | Staton et al. (2016) |
| Speed limit enforcement | 52.6% | Elvik. (2012) |
| Speed humps of trapeze shape | 100.0% | Jateikiene et al. (2016) |
| Raised pedestrian crossings | 83.0% | Jateikiene et al. (2016) |
| Speed bumps | 73.0% | Jateikiene et al. (2016) |
| Red light camera | 22.5% | Lee et al. (2016) |
| Section control | 56.0% | Høye. (2014) |
| Section control | 49.0% | Høye. (2015b) |
| Fixed speed camera | 51.0% | Høye. (2014a) |
| Fixed speed camera | 17.0% | Høye. (2015a) |
| Roundabout | 73.0% | Elvik. (2017) |

The second step was to estimate the population of Patiala City for the years 2019, 2025, and 2030. Simultaneously the vehicle population data was obtained from the Regional Transport Office (RTO) of Patiala City for the years 2012–2017. This was used to calculate the number of vehicles of various modes for the years 2019, 2025, and 2030.

### Calculation of Scenarios to Achieve SDG 3.6

Based on the estimates illustrated in Tables 3–5, five scenarios were developed to localize the goals set by SDG 3.6 by the year 2030. The first scenario considers a case when no there are now new safety interventions is taken – business as usual (BAU). Subsequent scenarios take into account the listed interventions additively and showcase the percentage reduction in fatal crashes resulting from each interventions. The five scenarios are:

1. Business as usual (BAU).
2. Introduction of vehicle safety devices.
3. Introduction of vehicle safety devices + seat belt and helmet enforcement.
4. Introduction of vehicle safety devices + seat belt and helmet enforcement + road infrastructure changes.
5. Introduction of vehicle safety devices + seat belt and helmet enforcement + road infrastructure changes + driving under influence (DUI) enforcement.

Figures 14 and 15 show the reduction in fatalities for each scenario (for Patiala and Bulandshahr respectively). The results are based on the detailed methodology

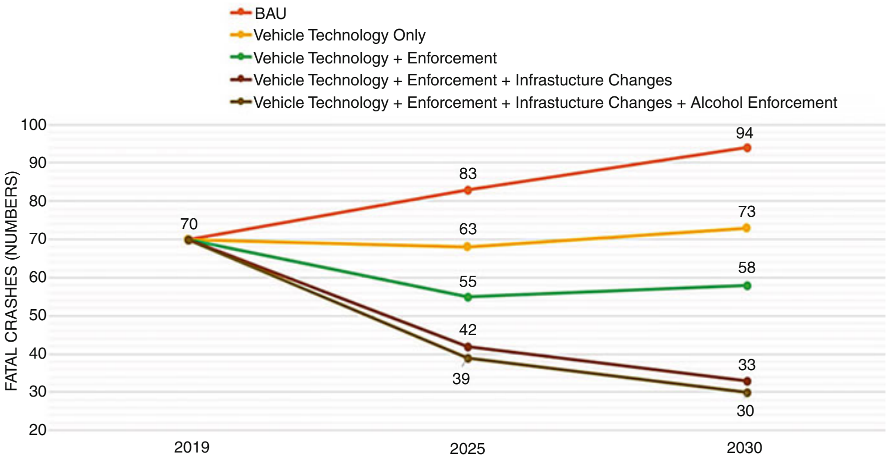



**Fig. 14** Reduction in road fatalities by 2030 in Patiala

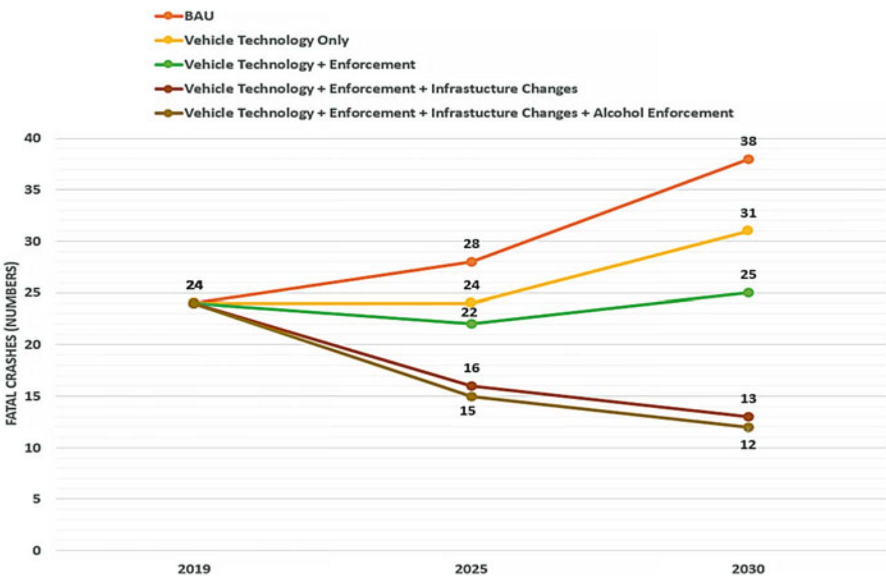



**Fig. 15** Reduction in road fatalities by 2030 in Bulandshahr

presented by Mohan et al. (Mohan et al. 2021). As can be inferred from Figs. 14 and 15, the maximum impact in fatality reduction comes from the improvement in road infrastructure. Though this requires both time and monetary investment by the city administration, achieving SDG 3.6 is not possible without this intervention. The quickest and the easiest method to reduce fatal crashes is the enforcement of seat belts and helmets for cars and motorized two-wheelers respectively.

## Vehicle Crashworthiness Standards (ECE and NCAP) for Promoting Road Safety Worldwide

In this section, we examine the role of automobile safety standards in decreasing RTI death rates around the world. An important stream in global intervention is in the promotion of universal motor vehicle safety standards. There are two approaches to improving car design: (1) legislation that prescribes requirements with which vehicle manufacturers need to comply and (2) information programs by organizations like NCAP (Global NCAP. http://www.globalncap.org/. Accessed 7 July 2019.) (New Car Assessment Program) around the world (ASEAN NCAP, Euro NCAP, Global NCAP, Latin NCAP, US NCAP, etc.) and the Insurance Institute for Highway Safety that provide safety ratings for cars and create a market for safer vehicles.

The WHO Status Report (WHO 2018) recommends that all countries should adopt the UNECE WP.29 motor vehicle safety standards and provides a list of eight to be prioritized for implementation by countries (Table 6). (WP.29 – Introduction. https://www.unece.org/trans/main/wp29/introduction.html. Accessed 7 July 2019) They also note that "New Car Assessment Programmes (NCAPs) have proved highly effective in raising the levels of vehicle safety significantly above the minimum regulatory requirements."

The regulatory aspects have the possibility of being applied across the board to vehicles (e.g., for pedestrian safety, including bus-pedestrian). Even though the

**Table 6** Priority UN vehicle safety standards. (Source: WHO 2018)

| No. | Standard |
|---|---|
| **1&2** | Frontal impact protection and side impact protection (R94 and R95):Ensure that cars withstand the impacts of a frontal and side impact crash when tested at certain speeds. These crashworthiness regulations help to protect occupants withstand the impact of front and side impact crashes. |
| **3** | Electronic stability control (R140): Prevents skidding and loss of control in cases of oversteering or understeering and is effective at reducing crashes and saving lives. It is effective in avoiding single car and roll over crashes, reducing both fatal and serious injuries. |
| **4** | Pedestrian front protection (R127): Provides softer bumpers and modifies the front ends of vehicles (e.g. removes unnecessarily rigid structures) that can reduce the severity of a pedestrian impact with a car. |
| **5–6** | Seat-belts and seat-belt anchorages (R14 – R16): Ensure that seat-belts are fitted in vehicles when they are manufactured and assembled and that the seat-belt anchor points can withstand the impact incurred during a crash, to minimize the risk of belt slippage and ensure that passengers can be safely removed from their seats if there is a crash. |
| **7** | Child restraints (R129): Ensure that the child seat is in place with the adult seat-belt and that ISOFIX child restraint anchorage points are fitted to secure the restraint. |
| **8** | Motorcycle antilock braking systems (R78): Help the rider maintain control during an emergency braking situation and reduce the likelihood of a road traffic crash and subsequent injury. |

NCAP safety market applies primarily to occupants, pedestrian test results are a component of the Euro NCAP star rating system, but this is not the case in the USA.

Safer cars have had a major role in reducing RTI fatality rates in HIC over the past 40 years. Estimates for the USA suggest that the fatality risk in the average car or light transport vehicles in 2012 was 56% lower than in the average vehicle on the road in 1960(Kahane 2015). In the USA, there were 33,561 fatalities on roadways in 2012, which means an estimated 45% was prevented due to automobile safety standards. If in a country vehicle occupant deaths contribute only 20% instead of 64% of the total count, then it is possible that reduction in deaths due to automobile safety standards would be less than 15%.

Almost all our understanding of road safety issues derives from the experience of about a hundred years of motorization in the HIC of today. This experience is based on traffic systems where the safety of car occupants remained the central concern. In these countries cars have been the dominant part of traffic systems unlike in many of the LMICs where motorized two-wheeler and para-transit vehicles like three-wheeled taxis (TWT in this paper), *tuk-tuks*, and *jeepneys* constitute a significant proportion of traffic on roads. Since we do not have detailed epidemiological studies on the effect of these latter vehicles on traffic safety in LMIC, we do not have a good understanding of the risks faced by occupants of these vehicles where they are a dominant mode of transport.

Figure 16 shows the proportion of car and vulnerable road user (VRU – occupants of 2−/3-wheelers, cyclists, and pedestrians) fatalities in selected countries (for India only – Mohan et al. 2015; WHO 2015). In Cambodia, Colombia, India, Sri Lanka, and Thailand, car occupants comprise less than 20% of road traffic fatalities. Even in HICs like Japan, the Netherlands, Hungary, Poland, and Greece, VRUs constitute more than 50% of the fatalities. Figure 17 shows the total population of countries included in Fig. 16 with car occupant fatalities greater than 40% and VRU fatalities greater than 60%. We would probably get similar population ratios if we included all the countries in the world; however, it is not possible to make an accurate assessment as reliable figures for modal share of fatalities are not available for all countries.

The above analysis indicates that while it is important to establish the latest level of vehicle safety performance whether by government standards or NCAP-type testing worldwide, it should be noted that this alone will not reduce overall death rates in LMIC as the HIC experience indicates. However, it is important to understand that although improved automobile safety performance may not result in as dramatic a reduction in fatality rates in LMIC as in HIC, hundreds of thousands of people are maimed and killed in cars all over world, and they must have access to the best safety systems available as soon as possible. Another reason why implementation of the latest safety performance in LMIC would be beneficial for car occupants is that many of these countries have a much younger fleet than HIC (Fig. 18). While car sales have plateaued in HIC, sales are still increasing in most LMICs. Therefore, early implementation of the latest safety performance would result in a faster fleet replacement with the best safety features in LMIC than in HIC.

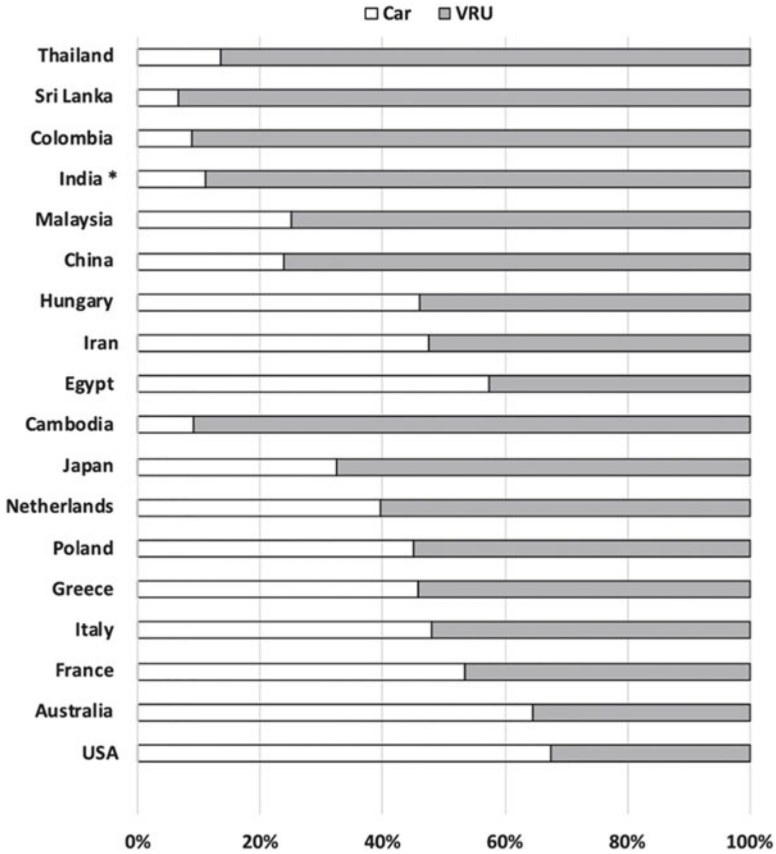



**Fig. 16** Proportion of car and vulnerable road user (VRU: occupants of 2–3-wheelers, cyclists, and pedestrians) fatalities in selected countries. (Source: WHO 2015). Data for India from Mohan et al. (2015))

**Fig. 17** Population of countries included in Fig. 16 according to proportion of car occupant and VRU fatalities

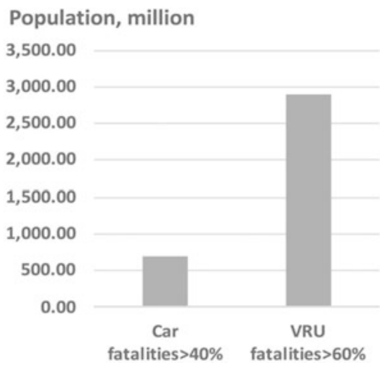
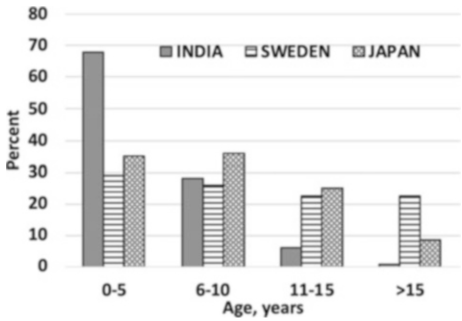


**Fig. 18** Age of cars on the road in India, Sweden, and Japan in 2015




## Relationship Between MTW Share in Vehicle Fleet, Pedestrian Exposure, and Fatalities

A thought experiment can be conducted to examine what would happen if the countries with very low fatality rates today had a much higher proportion of MTW in the fleet and a much higher exposure of pedestrians. Here we take the example of India, Japan, and Sweden. India, Japan, and Sweden had fatality rates of ~12, 4.7, and 2.8 per 100,000 persons, respectively, in 2013. If we keep the total number of vehicles constant in Sweden and Japan but change the fleet composition to 75% MTW and 25% cars, double the exposure of pedestrians, and then calculate overall fatality rates using risk of fatalities per unit vehicle and pedestrian per population constant for both countries, then we get the results as shown in Fig. 19. The estimated results show that the total number of deaths increases significantly in Japan and Sweden and the estimated fatality rates increase to 7 and 8.2, respectively. These estimates indicate that significant gains in traffic safety in HIC are partly due to the reduced exposure of VRU and not only due to the effect of safety policies. Since a large number of LMICs are not likely to reduce VRU exposure significantly in the next decade, exclusive focus on NCAP standards will not produce dramatic results in LMIC as they did in the HIC in the past. This thought experiment also suggests that it may not be possible for LMIC to reduce fatality rates below about 7 per 100,000 population along with high exposure of VRUs unless there are innovative developments in road design and vehicle safety standards including all indigenous intermediate transport vehicles with special emphasis on VRU protection.

## Safety Standards for Vehicles Other than Cars (Not Covered by NCAP at Present)

### Safety of Para-Transit Vehicles (Three-Wheeled Scooter Taxis)

Studies comparing the safety of large cars with small cars have consistently found that larger cars provide better protection than small cars (Broughton 2008; Buzeman

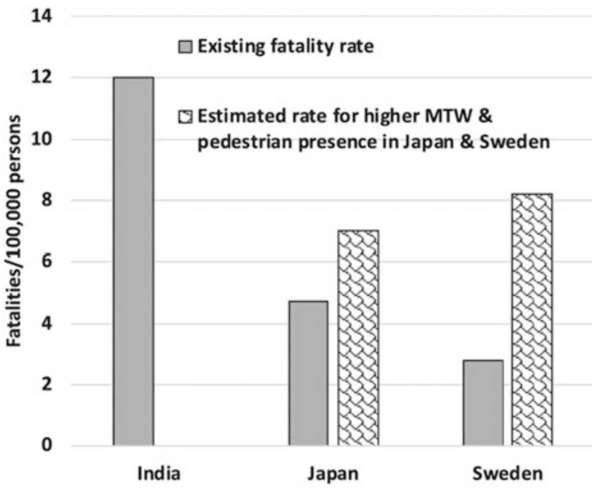



**Fig. 19** Existing fatality rates in India, Japan, and Sweden and estimated rates in Japan and Sweden if they had 75% MTW in their fleet and 2 times the exposure of pedestrians. *Assumption: Occupant risk per vehicle and pedestrian risk per population remain constant

et al. 1998; Wood 1997). All these studies have been done in HIC where cars of all sizes are capable of the same driving speeds. Personal fatality risk for various vehicles in four Indian cities has been calculated by dividing vehicle-specific occupant fatality rates by estimates of the average daily occupancy of each vehicle. The occupancy rates for MTW, car, and TWT were estimated to be 4, 7, and 60 persons, respectively, per day (Chanchani and Rajkotia 2012; Mohan and Roy 2003; Wilbur Smith Associates 2008). The results of these calculations are shown in Fig. 20 (Mohan et al. 2016). Given the present trip lengths for each vehicle type, MTW riders are 3–6 times more at risk than car occupants. The MTW fatality rates per trip in Agra and Vishakhapatnam are much higher than those in the other three cities. The reasons for this are not known at present. At an individual level, risk per trip seems to be the lowest for TWT occupants in all the cities under the assumed occupancy rates and number of trips per day. This is a very surprising finding because average speed of TWT is much lower. TWTs weigh less than a third of cars, have no surrounding steel shell, and have to subscribe to only minimal safety standards.

Figure 21 shows all the fatalities associated with each vehicle type per 100,000 vehicle km per day. We assumed the following daily travel distance values for the different vehicle types: bus 150 km, car 50 km, TWT 150 km, and MTW 25 km. This is based on trip distances/lengths that each vehicle covers daily. The data include fatalities of occupants and road users other than vehicle occupants. For example, if a motorcycle hits a pedestrian and the pedestrian dies, the pedestrian death is also associated with the motorcycle. This index gives a rough idea of the total number of fatalities one might associate for each vehicle type given the present traffic conditions and mode shares. Essentially, the figures indicate that the low rate for TWT relative to cars is due to the higher number of passengers carried by TWT per day. These indices appear to suggest that, on a travel distance basis, TWT, MTW, and cars

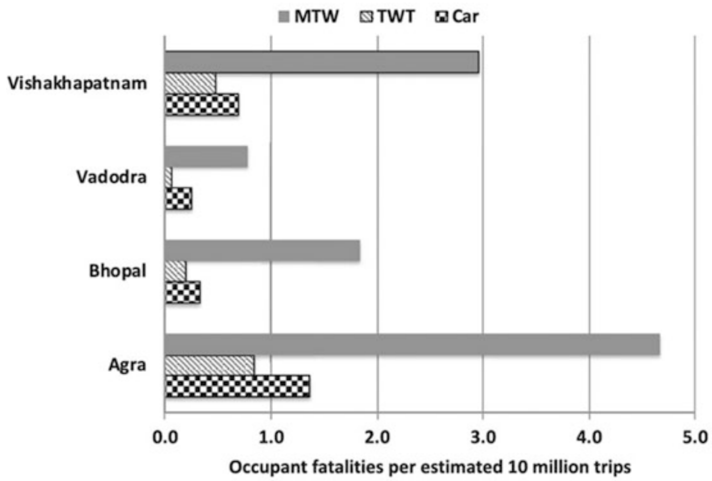



**Fig. 20** Fig. 8. Personal fatality risk per 10 million trips for occupants of motorized two-wheelers, TWT, and cars in four Indian cities. (Source: Mohan et al. 2016)

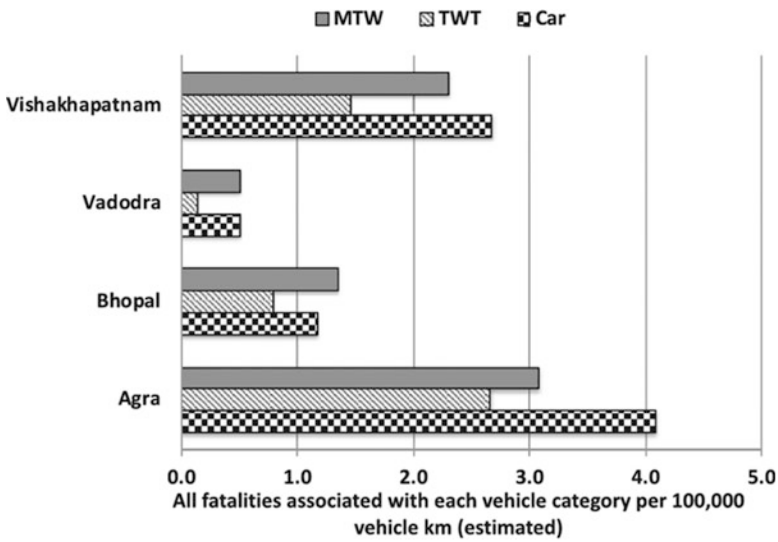



**Fig. 21** All fatalities associated with each vehicle category per 100,000 vehicle km (estimated) in four Indian cities. (Source: Mohan et al. 2016)

may pose roughly similar level of danger to society under the present conditions. Safer design is a pressing concern for TWT, which are threats to both their occupants and the VRU that they impact.

No previous studies are available on safety records of motor vehicles that are not capable of high speeds operating in mixed traffic in urban areas. TWTs operating in

Indian cities have engines smaller in size than 175 cc and generally cannot exceed velocities greater than 50 km/h. The experience of TWT in Indian cities suggests that small lightweight vehicles with limited speed capabilities operating in the urban environment can result in low occupant fatality rates. The lower operating speed of TWT also implies that they pose a much lower risk to pedestrians, bicyclists, and other road users. This issue needs to be studied in greater detail, and if found true, it may be suggested that different crashworthiness standards or NCAP tests need to be developed for low-mass vehicles incapable of operating at speeds greater than 50 km/h. Such vehicles may be optimal for urban use and could be prohibited for roads with speed limits greater than 50 km/h.

It may not be possible for LMIC to reduce fatality rates below about 7 per 100,000 population along with high exposure of VRUs unless there are innovative developments in road design and vehicle safety standards including all indigenous intermediate transport vehicles with special emphasis on VRU protection.

## Designs and Specifications

At the operational level, it is the state (public authority) that has the primary obligation for ensuring the people's right to road safety since the state is granted sovereign powers through the mutual transference of the powers of the citizens to the state by way of a social contract. At the implementation level, both roads and vehicle design, investments in research, and new knowledge generation are required.

Roads have become relatively safer in many high-income countries mostly due to improved geometric standards. Appropriate legislation regarding seat belt use, speed limits, and alcohol control has also contributed to improved safety. Often road standards (geometric design standards) in India have been based on either UK or USA design manuals. There are two important concerns in using or developing highway design standards mainly based on those in use in the USA or UK. The traffic mix for which these standards have been developed is very different from the traffic existing in India. The second concern is whether the design standards in HICs are based on traffic safety science (Hauer 1988).

Traffic crash patterns in India are substantially different compared to North America and Western Europe. Pedestrian and motorcyclist involvement in fatal crashes on rural highways is greater than that of other road users. These highway crash patterns are similar to those observed in urban areas. In North America, 10% of the fatal crashes on highways involve pedestrians. The presence of motorcycles is negligible, and long stretches of roads pass through wilderness. A large proportion of the highways is access controlled and designed for four-wheeled motorized traffic. Therefore, the road standards that have evolved to make access controlled highways safe for motorized vehicles may not ensure safety to other road users present on LMIC highways. However, in India standards similar to those in HICs have been adopted (IRC 2007; MoRTH 2010). In the past two decades, major investments have gone into expanding the national highway system in India. Yet the number of fatalities has continued to grow. The density of highways in a state and the number of fatalities seem to have a strong correlation. There is a strong reason to question the safety aspects of current standards in use.

Hauer (1988) has made important observations for North American roads: "No road in use is entirely crash-free, and therefore, in the interest of honest human communication no road can be called safe. The safety of a highway does not change abruptly when some highway dimension changes slightly. It follows that meeting or not meeting a dimension standard does not correspond to a road being 'safe' or 'unsafe'. Also, highway design standards evolve with time. We used to build lanes 3.6m (12 feet) wide, now the standard calls for 3.75m wide lanes. This does not mean that the entire stock of old highways with 3.6m lanes is unsafe. It means only that the information, the judgements, and the economic considerations that go into the formulation of design standards change in time. In short, highway design standards are not the demarcation line between what is safe and unsafe. They are a reflection of what a committee of professionals of that time considers to be overall good practice." These observations are valid for India too. Road standards set by Indian Roads Congress in India are based on committees where the membership includes practicing and retired professionals and academics. IRC does not have a rigorous process of synthesizing results of systematic reviews and scientific studies to propose or modify standards and monitor the impact of new standards.

Road infrastructure improvements (e.g., road upgrading and pavement) and roundabout design are found to be beneficial for safety. In the case of HICs, not only does better vehicle design but also improvements in road safety engineering reduce the severity of whiplash injuries when accidents occur, and this could be done by enhanced signal visibility or through complex intersection geometric upgrades (Navin et al. 2000; Perez 2006). In the case of countries like India, the safety benefit of roundabouts is clear; however, upgradation involving improved pavement surface, wider lanes, and wider shoulders may lead to higher speeds and increase opportunities for lane changing and conflicts. Pedestrians and slow vehicles on the curbside lane or shoulders will be exposed to motorized vehicles moving at much higher speeds. Safety benefit of road upgradation using the present standards is unclear for Indian highways.

Safe systems approach has three key principles (H. Y. Chen and Meuleners 2011; Transport Research Centre 2008):

- Principle 1 – Recognition of human frailty
- Principle 2 – Acceptance of human error
- Principle 3 – Creation of a forgiving environment and appropriate crash energy management

Current highway standards for geometric design of highways can be reviewed in the context of these three basic principles. Principles 1 and 2 must recognize that highways in India will have the presence of NMVs and pedestrians along with motorized traffic. Principle 3 becomes the operational principle for setting appropriate speed limits for ensuring a forgiving environment for all road users. Pedestrians will make mistakes in judging the possible risk in the system, whereas drivers can make mistakes in adopting an appropriate speed.

Design speed and design vehicle are the two most important elements which have been used to set highway standards in the past. Stopping distance of a modern car is very different from a tempo (three-wheeler) or two-axle trucks present on Indian highways. Therefore, selection of a design vehicle itself becomes important for setting the minimal standards for stopping distance, sight distance, and overtaking distances.

*Design speed* governs the design of horizontal curve, vertical curve, and the safe stopping distance. Conventional practice of keeping design speed higher than operational speed has been questioned by several researchers. Therefore, the design speed must be in line with the requirement of principle 3 "Creation of a forgiving environment and appropriate crash energy management." This implies that for setting appropriate design speed, presence of NMVs, presence of activities along the highway, and density of built up area along the highway and frequency of towns and villages through which the highway passes must be taken into consideration. Design speed may vary from 30 km/h to 90 km/h with a road cross-section designed for appropriate crash energy management depending on the surrounding land use present along the highway.

*Speed compliance by design*: We started this paper quoting the success of legislation and enforcement; however, taking lessons from a number of studies in HICs, the most effective measure for speed compliance in India will be by design: active speed control measures. India has weak institutional capacity and weak enforcement of legislation; therefore, speed control by texture change, audible markers, rumble strips, change in geometric standards, median designs, lowering speeds at intersections by introducing roundabouts, raised stop lines, and speed humps on minor roads are expected to be more successful in speed compliance by all road users – good drivers, bad drivers, young drivers, knowledgeable drivers, drivers with poor driving education, etc. – ensuring compliance with the principle 2.

Many of the current standards for highway cross-section require revisions (Chen and Meuleners 2011; Mohan et al. 2017b) to comply with principle 3. Appropriate design of service roads, width of shoulders, and design of medians have to be reviewed to ensure safe designs for NMVs and different kinds of vehicles on the road.

## Conclusions

The discussion above suggests that the previously assumed relationships between national incomes and RTI fatality rates (initial increase in deaths with increasing incomes and a subsequent decrease) may not be correct, and national income levels cannot be taken as an excuse for inefficient data collection systems or lack of safety on roads. Therefore, moving toward a target of zero deaths on the roads is a logical policy to be adopted by all countries.

However, we are likely to encounter many obstacles as we try to implement policies underlying Vision Zero:

- In most LMICs a large proportion (>60%) of RTI those getting killed in urban areas and on highways vulnerable road users. On the other hand, in the USA an estimated 45% fatalities were prevented due to automobile safety standards and NCAP-type testing. If in a country vehicle occupant deaths contribute only 20% instead of 64% of the total count, then it is possible that reduction in deaths due to automobile safety standards would be less than 15%. Since a large number of LMICs are not likely to reduce VRU exposure significantly in the next decade, exclusive focus on NCAP standards will not produce as dramatic results in LMIC as they did in the HIC in the past. There is a need for the development of suitable vehicle safety standards including all indigenous intermediate transport vehicles.
- Significant gains in traffic safety in HIC are partly due to the reduced exposure of VRU and not only due to the effect of safety policies. VRU trips have been reduced in many HICs for various reasons such as land use patterns requiring long commutes, easy access to cars, etc. It may not be possible for LMIC to reduce fatality rates below about 7 per 100,000 population along with high exposure of VRUs unless there are innovative developments in road design (including roundabouts, bicycle lanes, and expressways) with special emphasis on VRU protection.
- Fatality rates across cities and countries that have similar income levels can vary greatly. At present we do not know all the reasons behind these variations. It would be important to investigate why rates are so different across cities in the same country. These findings might give us new clues on planning for Vision Zero.
- The issue of serious injuries and fatalities among pedestrians hit by motorcycles has not received much attention internationally. Since the use of motorized two-wheeler for personal transport and deliveries is increasing in a large number of countries, it is necessary to give greater attention to safer motorcycle design and management of their movement on city roads.
- Very little effort has gone into the development of new knowledge, road designs, or vehicle safety specifications in most LMICs. Local research capabilities and resources for scientific research remain low.

Because of these reasons, road safety priorities may have to be very different in India and many other countries, and some new safety interventions would have to be developed to move toward Vision Zero. Translating Vision Zero requires efforts at several levels. At a very macro level, it involves the concept of "right to safety" enshrined in our constitution. A "right" to safety can exist only when there exists a relationship between individuals or groups using a product or services and the provider of those products or services. Constitutions of most countries ensure that their citizens have a right to life, and it is this right that gets translated into a right to live free from debilitating injury. Article 21 of the Constitution of India, 1950, provides that, "No person shall be deprived of his life or personal liberty except according to procedure established by law." "Life" in Article 21 of the Constitution is not merely the physical act of breathing. It does not connote mere animal existence or continued drudgery through life. It has a much wider meaning which includes right to live with human dignity, right to livelihood, right to health, right to pollution-free air, etc. Individuals and communities need to understand that a right to safety on the road is as valid as a right to clean air or a right to live free of small pox, polio, or malaria.

The first step forward would be for policy-makers in all countries to acknowledge that road users have a right to expect that state decisions affecting their safety should be based on fact-based expectation of the safety consequences of such decisions. This would require every policy, law, or safety standard (concerning roads, vehicles, or traffic management) established by the state to be accompanied by a justification for the same by including systematic reviews of the scientific evidence used for the decision and the expected safety benefits in numerical estimates. The document would have to include information on what effects that measure would have on all road users and non-road users on their daily lives. These documents would obviously have to be placed in the public domain.

The second step would be for manufacturers of vehicles and other road-based technologies to explicitly state the quality and limits of the safety features embedded in their technologies. For example, a car manufacturer would have to state that the car has been tested for frontal impacts at say 60 km/h, that its speed reduces fatality rates by approximately x%, and that it may not be as safe at speeds above that limit.

The third step would be for international agencies dealing with road safety (state and non-state) to examine all sources of systematic reviews of road safety interventions and use them to justify the policies they pursue. They should also make it explicit that they will fund road safety activity by non-government organizations only if they promote interventions justified by scientific evidence. If they diverge from available evidence, then they must provide justification for doing so.

The proposed measures should help us move in a path that leads us to a situation that actually establishes Vision Zero as a right enjoyed by all road users and the accompanying obligations of the state and the private sector that accompany that right. The exact modalities of implementing the suggestions successfully will only come with experience.

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# 20 Vision Zero in the United Nations

Meleckidzedeck Khayesi

## Contents



**Abstract**

This chapter examines the development and use of Vision Zero policy and its related strategy, safe system approach, in the road safety programs of the United Nations and its specialized agencies. The chapter shows that progressively, Vision Zero moved from being cited in documents as an example of a transformative policy to being promoted as a way of thinking about or approaching road safety for countries to adopt. In addition, it has been used as a principle in the *Road safety strategy for the United Nations System and its personnel*. This strategy embraces the ethical imperative that "no road users, including pedestrians, should be killed or seriously injured in road crashes involving United Nations vehicles." It commits United Nations organizations to Vision Zero. It calls for a shift from a traditional road safety approach to a safe system approach.

**Keywords**

United Nations · World Health Organization · United Nations Road Safety Collaboration · Resolutions · Injury · Violence · Vision Zero · Safe system approach · World Health Assembly · United Nations General Assembly

M. Khayesi (✉)
Department of Social Determinants of Health, WHO, Geneva, Switzerland
e-mail: khayesim@who.int


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## Introduction

Vision Zero is currently emphasized as an ideal principle or aspiration to pursue in the internal road safety strategy of the United Nations (United Nations 2019). This development shows how Vision Zero has traveled from Sweden and penetrated road safety policy discourse not only in countries and cities but also in international organizations. How did this development happen? How is Vision Zero reflected in the road safety policies and programs of the United Nations? These two questions constitute the focus of this chapter which examines the development and use of Vision Zero as an ideal principle or aspiration in the road safety programs of the United Nations and its specialized agencies. This chapter essentially examines turning points that led to Vision Zero becoming a key principle promoted or emphasized by the United Nations.

Vision Zero and its associated concepts are briefly clarified before moving to the rest of the analysis in this chapter. As already indicated, Vision Zero is a policy that advances the idea of no deaths and injuries on the roads (Belin 2012). Associated with this aspiration are three other concepts: safe system approach, sustainable safety, and Toward Zero. The safe system approach is a holistic and proactive strategy that seeks to realize the aspiration of Vision Zero through managing the elements of the road transport system to prevent crashes and reduce their impact when they occur (International Transport Forum 2016). Sustainable safety is the approach adopted by the Netherlands toward improving its road safety along the lines that Sweden pursued (Peden et al. 2004; Weijermars and Wegman 2011). While some scholars see sustainable safety as the Dutch version of Vision Zero, others perceive the two to be different. The concept of Towards Zero expresses the idea that the emphasis should be on the effort or process toward zero deaths. New Zealand uses the idea of “Road to Zero” in its 2020–2030 road safety strategy (New Zealand Government 2019). There is also an organization with the name “Towards Zero Foundation,” seeking to realize the ideal of a world free from road traffic fatalities and serious injuries by promoting safe and sustainable mobility (Towards Zero Foundation 2020). Thus, Vision Zero was a new idea that has inspired other concepts.

## Road Safety in the United Nations and Its Specialized Agencies Before Vision Zero

One of the chapters in this handbook discusses the development and adoption of Vision Zero by Sweden in 1997. This section examines road safety in the United Nations before Vision Zero was formulated or adopted. The United Nations and its specialized agencies such as the World Health Organization (WHO) and United Nations Economic Commission for Europe have been concerned about the prevention of road traffic injuries for several years., implying that the recent road safety efforts in the United Nations are part of an evolving policy. A paper on road traffic injury data mentions discussions on road safety at WHO in 1946, when WHO was formed and inherited the health functions of the health division of the League of Nations (World Health Organization 1972). One of the key roles that the League of Nations played was promoting the need for official road traffic injury statistics, different from general statistics on the causes of death.

Another United Nations agency that was established in 1947 was the United Nations Economic Commission for Europe (UNECE) (2017). UNECE established a transport division in 1947. This division has focused on road safety and other transport topics. It created a Working Party on Road Traffic Injury that has revised several road safety agreements and regulations as needed. The work of UNECE on road safety conventions and agreements is highlighted in different parts of this chapter. UN Economic Commissions in other regions also focus on road safety.

The Geneva Convention on Road traffic was signed on 19 September 1949 in Geneva, Switzerland (UNECE 2017). It entered into force on 26 March 1952, addressing minimum mechanical and safety equipment needed to be onboard, and defines an identification mark to identify the origin of the vehicle (Wikipedia 2020). This and other subsequent conventions became the core work of UNECE.

In 1961, World Health Day, observed every year on seventh April in honor of the date WHO was created, was dedicated to "Accidents and their Prevention." This was followed by a comprehensive report on the epidemiology, control, and prevention of road traffic accidents in 1962 (Norman 1962). This report discussed the nature and dynamics of the problem. It should be noted that WHO has played an important role in the epidemiological analysis of the magnitude and effects of road traffic injuries. For example, mortality from road traffic crashes, with special reference to motor vehicle collisions for the period 1950–1962, was the special subject in the Epidemiological and Vital Statistics Report of 1965.

In 1966, the World Health Assembly, the decision-making body of WHO, adopted resolution WHA19.36 which requested "the Director-General to consider the possibilities of WHO playing a more active role in the prevention of traffic accidents, with special emphasis on human and medical aspects of the problem and on the coordination of international research in this field" (WHO 1966). There was a discussion on road traffic injuries in the WHO Executive Board of 1969 that suggested that WHO should continue its close collaboration with the national, intergovernmental, and nongovernmental organizations working in this field (WHO 1969). These two examples indicate that road traffic injuries received attention from key decision-making bodies at WHO such as the World Health Assembly and Executive Board.

Another key development in the 1960s was the United Nations Conference on Road Traffic held from 7 October to 8 November 1968 in Vienna, Austria. The International Labour Organization, the World Health Organization, and the International Atomic Energy Agency were represented at the Conference in a consultative capacity. A major outcome of this Conference was the signing of the Convention on Road Traffic (UNECE 2017). This convention formed the basis for the work of UNECE, one of whose key activities "is the updating of the existing legal instruments in the field of road transport administered by ECE, such as the Vienna Convention on Road Signs and Signals and on Road Traffic of 1968, and the 1971 European Agreements supplementing them" (UNECE 2008). UNECE has carried on this work over the years and has regularly updated these legal instruments for road safety. There are currently six priority road safety conventions that UNECE and its member countries have produced for Europe and the rest of the world. These are:

- The 1968 Convention on Road Traffic
- The 1968 Convention on Road Signs and Signals
- The 1958 Agreement concerning the adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment, and Parts which are fitted and/or Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations
- The 1997 Agreement Concerning the Adoption of Uniform Conditions for Periodical Technical Inspections of Wheeled Vehicles
- The 1998 Agreement concerning the Establishment of Global Technical Resolutions for Wheeled Vehicles, Equipment, and Parts
- The 1957 Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)

These conventions provide the basis for states to develop national legal frameworks on road safety. In addition to these conventions, UNECE produced a consolidated resolution on road traffic in 2010, aimed at supplementing the 1968 Convention on Road Traffic and the 1971 European Agreement, covering subjects not considered in these conventions (UNECE 2010). Further, the International Transport Forum, EUROSTAT and UNECE produced the fourth edition of illustrated glossary for transport statistics, which includes key definitions on road traffic injuries (International Transport Forum, EUROSTAT and UNECE 2010).

In 1974, the World Health Assembly adopted Resolution WHA27.59, declaring road traffic accidents a major public health issue and calling for Member States to address the problem (WHO 1974). In the 1970s and 1980s, the World Health Organization adopted primary health care as a strategy to address health issues in member states. One of the elements of this strategy was community involved. It is therefore not surprising that a WHO road safety technical report on “New approaches to improve road safety” has an annex on the development of a community-based accident prevention program that emphasizes the role of local accident prevention groups and national accident prevention councils (WHO 1989). There were other road safety efforts going on in the world in the 1980s. For example, the safe community movement, which had origins in Sweden, was established toward the end of the 1980s, following the first World Conference on Accident and Injury Prevention, which was held in 1989 in Stockholm. The safe community movement creation was in line with a major premise of the conference that community-level programs for injury prevention are key to reducing injuries (Rahim 2005).

Administratively, within WHO, there was an effort to decentralize coordination of some global programs from headquarters to regional offices in the 1980s as part of institutional restructuring approach during the leadership of Director-General Halfdan Mahler. This is the context in which the global coordination of road safety work was conducted by the WHO office of the European region during this period.

There were other external developments in the 1980s and early 1990s that laid the groundwork and provided space for conversations on road safety research and policy. For example, the first conference Road Safety on Four Continents was held in 1987. Within a space of 2 years, as already noted, the first World Conference on Accident and Injury Prevention was held in 1989 in Stockholm. This conference was the mustard seed for a series of World Injury Conferences that are currently a key global forum for interaction and conversations on science, policy, and practice of injury prevention. A conference on vulnerable road users was held in 1991 in New Delhi, organized by the Indian Institute of Technology Delhi and World Health Organization. The conference issued a declaration on vulnerable road users, calling for better planning for these key road users (International Conference on Traffic Safety 1991).

In 1993, the World Health Day, with the theme "Handle life with care" (WHO 1993), was dedicated to violence and injury prevention. Road traffic injury prevention was one of the topics highlighted. The Global Burden of Disease in 1996 projected road traffic injuries to become the third contributor to global burden of disease by 2020 (Murray and Lopez 1996). This study, funded by the World Bank, drew the attention of WHO and its member states to a growing global health problem of road traffic injuries. UNECE continued with its work on road safety conventions and agreements. Other United Nations Economic Commissions also continued with their activities on road safety.

## Road Safety in the United Nations and Its Specialized Agencies After Vision Zero

This section examines road safety in the United Nations after Vision Zero was adopted in Sweden. Given the growing attention to road traffic injuries, the World Health Organization established the Department of Injuries and Violence Prevention within the Cluster of Noncommunicable Diseases and Mental Health in March 2000 to facilitate a coordinated response to road traffic injuries and other injuries. For the 17 years prior to this, injuries and violence prevention had been housed as a unit within three consecutive departments: Department of Health Protection and Promotion, the Department of Emergency and Humanitarian Action, and the Department of Disabilities, Injuries Prevention, and Rehabilitation. Road traffic injuries prevention was identified as one of the focal activities for this department. The other was interpersonal violence.

The creation of a department devoted to injuries and violence prevention led to a major change in the focus and approach to road traffic injuries within WHO. In 2001, WHO produced a 5-Year Strategy for Road Traffic Injury Prevention (Peden et al. 2001). It emphasized a public health approach to road traffic injury prevention, consisting of problem definition, identifying and implementing interventions, and evaluating these interventions. The objectives of the strategy were:

- To build capacity at a national and local level to monitor the magnitude, severity, and burden of road traffic injuries
- To incorporate road traffic injury prevention and control into public health agendas around the world
- To promote action-oriented strategies and advocate for prevention and control of the health consequences of motor vehicle collisions

Several road safety activities were undertaken within the framework of this strategy: development of normative documents, implementation of country demonstration projects, and advocacy and revitalization of WHO Helmet Initiative. In 2001, WHO secured financial support from the Federation Internationale de l'Automobile Foundation, which enabled WHO to start supporting pilot road safety programs in five focal countries: Cambodia, Ethiopia, Mexico, Poland, and Vietnam. In addition to projects in the five countries, WHO developed a road safety report between 2002 and 2004. The year 2004 was a significant milestone in the road safety work of WHO since World Health Day 2004 was dedicated to road traffic injury prevention. The theme was "Road Safety," drawing the attention of the world community to the growing problem of road traffic injuries and the need to step up interventions. World Health Day is one of the major advocacy opportunities for public health. Activities were organized at the global, regional, national, and local levels, engaging millions of people worldwide and raising awareness effectively. On that same day, 7 April 2004, WHO launched the *World Report on Road Traffic Injury Prevention*. The report provided a global reference on the magnitude of the problem and pointed out directions for road traffic injury prevention. There were also regional reports like the one for the European Regional of the World Health Organization that tailored the content and recommendations to issues relevant to the regional settings. The report was used not only as a wake-up call but also as a tool to be used by governments, industry, and civil society in all countries to identify some of the actions they need to take to reduce this burden in their own country. Its six recommendations provided a basic framework of action that road safety stakeholders at national and international levels were expected to pursue (Peden et al. 2004):

- Identify a lead agency in government to guide the national road traffic safety effort.
- Assess the problem, policies, and institutional settings relating to road traffic injury and the capacity for road traffic injury prevention in each country.
- Prepare a national road safety strategy and plan of action.
- Allocate financial and human resources to address the problem.
- Implement specific actions to prevent road traffic crashes, minimize injuries and their consequences, and evaluate the impact of these actions.
- Support the development of national capacity and international cooperation.

The preceding overview highlights that there were several turning points or actions in the United Nations after 1997 that eventually led to Vision Zero being used or promoted as a viable road safety strategy:

- Creation of a department devoted to violence and injury prevention in WHO
- World Health Day 2004 that was dedicated to road safety, on which occasion WHO and the World Bank released the *World report on road traffic injury prevention* (Peden et al. 2004)
- The initiation of the United Nations Road Safety Collaboration in 2005, coordinated by WHO and UN regional economic commissions
- Organizing United Nations Road Safety Weeks
- Passing of resolutions on road safety by WHA and UNGA
- Increased focus on road safety by several UN agencies and other organizations
- Decade of Action for Road Safety 2011–2020
- Holding of two/three global ministerial conferences on road safety
- Implementation of road safety programs in countries
- Appointment of the United Nations Secretary-General's Special Envoy for Road Safety
- Inclusion of road safety in the 2030 Agenda for Sustainable Development (United Nations 2015)
- Development of the Voluntary global performance targets for road safety risk factors and service delivery mechanisms (WHO 2017)

## Vision Zero in the United Nations Road Safety Documents and Programs

Vision Zero was cited as an example of a transformative policy in the *World report on road traffic injury prevention* (Peden et al.2004). It is described as a long-term strategy in which improvements are delivered in gradual increments, and where, over time, the responsibility for safety becomes shared by the designers and users of the road traffic system. The report argues that Vision Zero is relevant to any country that aims to create a sustainable road transport system, and not just for the excessively ambitious or wealthy ones. The report further posits that the basic principles of Vision Zero can be applied to any type of road transport system, at any stage of development. The report discusses Vision Zero within a framework of a paradigm shift in road safety policy. Other approaches discussed in the report are Haddon Matrix and public health approach.

The *Global Plan for the Decade of Action for Road Safety* (WHO 2011) indicated that its guiding principles are those included in the safe system approach. It emphasized that this approach aims to develop a road transport system that is better able to accommodate human error and take into consideration the vulnerability of the human body. The Plan reiterates the key principles of a safe system approach and advances a set of activities to be implemented under five pillars: road safety management, safer roads and mobility, safer vehicles, safer road users, and postcrash care.

In pursuit of the Decade of Action for Road Safety and the objectives of the United Nations Road Safety Collaboration, resolutions were passed by the United Nations General Assembly and World Health Assembly, calling for sustained action and spelling out key activities to be undertaken. Vision Zero is variously highlighted in these resolutions and other reports such as the United Nations Secretary General's reports on the global road safety crisis.

The safe system approach, a strategy related to Vision Zero, is described as an operational framework in several technical documents providing guidance on interventions. For example, a road safety package produced by WHO in 2017 reiterates that the Safe System Approach provides a viable framework to examine road traffic injury risk factors and interventions from a holistic perspective (WHO 2017). Like the *World report on road traffic injury prevention*, this document highlights the key principles of the Safe System Approach and presents 22 interventions that countries can implement. Examples of other documents that highlight the safe system approach or Vision Zero are pedestrian safety manual (WHO 2013) and powered two-and three-wheeler safety manual (WHO et al. 2017).

Another example of drawing on Vision Zero is in the *Road safety strategy for the United Nations System and its personnel* (UN 2019). This strategy makes explicit reference to Vision Zero, stating: "The strategy embraces the ethical imperative that 'no road users, including pedestrians, should be killed or seriously injured in road crashes involving United Nations vehicles.' The United Nations organizations hereby commit to 'Vision Zero.' The United Nations is engaged in developing a pro-active, forward-looking approach to road safety, which requires managing the interaction between speed, vehicles, road infrastructures and road user behaviours in a holistic manner" (UN 2019:8) It commits United Nations organizations to Vision Zero and calls for a shift from a traditional road safety approach to a safe system approach. It indicates it is based on a safe system approach and presents a set of activities under five pillars: road safety management, safer fleets, safer road users, postcrash response, and safer driving environment.

The trajectory presented in the preceding paragraph shows that, progressively, Vision Zero moved from being cited in documents as an example of a transformative policy to being promoted as a framework for countries to use. In addition, it has been used as a vision in the *Road safety strategy for the United Nations System and its personnel*. Vision Zero is promoted alongside other frameworks such as the public health approach. Vision Zero's emphasis on a system approach and evidence-based solutions is in line with effective solutions and integrated policy-planning perspective at the center of international health and development programs. Resolutions, documents, and strategies by UNRSC, UN, UNGA, and WHA have steadily referred to and used Vision Zero policy and its related strategy of safe system approach as an aspiration and a planning model to be used by organizations, countries, and cities in their road safety programs.

## Conclusion

The development of the road safety policy and programs in the United Nations and its specialized agencies such as the United Nations Economic Commission for Europe and World Health Organization has a long history, embedded in both internal and external institutional processes. Policy and programs advance not only specific interventions to solve a problem but also strategies, visions, and tools for institutions and countries to use. This chapter has traced turning points in the United Nations and its specialized agencies that led to Vision Zero moving from being cited in documents as an example of a transformative approach to being promoted as an ideal for countries to use. In addition, the chapter has shown that Vision Zero has recently been used as a vision in the *Road safety strategy for the United Nations System and its personnel*. This strategy embraces the ethical imperative that "no road users, including pedestrians, should be killed or seriously injured in road crashes involving United Nations vehicles." It commits United Nations organizations to Vision Zero. It calls for a shift from a traditional road safety approach to a safe system approach. The contribution of this chapter is in examining processes and contexts that either favor or hinder the promotion of a strategy or framework in an international context, in this case Vision Zero in the United Nations.

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# Towards a Potential Paradigm Shift: The Role of Vision Zero in Global Road Safety Policy Making

# 21

Ann-Catrin Kristianssen

## Contents



**Abstract**

Vision Zero is a term mainly connected to road traffic safety and has its roots in the Swedish road safety policy, although similar concepts are used in other countries. It was adopted by the Swedish Parliament in 1997, and due to the success of lowering the number of deaths in traffic crashes significantly, it has become an inspiration to road safety strategies in countries and cities all over the world. An important factor as to why Vision Zero diffuses is the incorporation of the vision in reports and strategies from international intergovernmental organizations and through the work of nongovernmental organizations. The development of finding a common global

A.-C. Kristianssen (✉)
School of Humanities, Education and Social Sciences, Örebro University, Örebro, Sweden
e-mail: ann-catrin.kristianssen@oru.se



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strategy for road safety has been an ongoing process for many years, and the purpose of this chapter is to map the role of Vision Zero in this global development process. This is performed by studying the integration of Vision Zero in the road safety work and strategies of key international intergovernmental and non-governmental organizations. The chapter also contains an account of possible opportunities and advantages of working with Vision Zero as a tool on the global level as well as the criticism towards the approach. This chapter discusses the content of what is being diffused, why it is diffused, who is diffusing, and how it is diffusing. The material consists of key global policy documents and 29 semi-structured interviews with senior experts working with road safety on a global level. The main conclusions are that Vision Zero is a well-established global road safety policy program and a road safety philosophy integrated into both the work and texts of the major intergovernmental organizations working with road safety. There is a widespread opinion that Vision Zero and other safe system approaches constitute a paradigm shift in global road safety work. It is regarded as an innovative and inspiring policy based primarily on its ethical approach. It is also regarded as a coherent policy program and rests firmly upon years of progress and experience. Even though many of the respondents are positive towards the ethical base and the systematic approach, there are still those who argue that Vision Zero cannot be used as a policy tool, at least not in low- and middle-income countries. It is obvious that Vision Zero is not interpreted and reproduced in the same way in all contexts, but the question is if that is part of a natural transformation process leading to new interpretations or if it is a problem for the Vision Zero trademark.

**Keywords**

Vision Zero · Global road safety policy · Global governance · Policy diffusion

## Introduction

Road injuries or road traffic crashes is one of the main health problems globally as 1.35 million people are killed in road traffic crashes yearly. It was the eighth cause of death in the world in 2018 and the leading cause of death for children and young adults aged 5–29. In comparison, deaths in road traffic crashes now supersede the number of deaths caused by HIV/AIDS (WHO 2018). In addition, it is estimated that 20–50 million people are injured in the road traffic every year. The burden of road traffic injuries is highly disproportionate hitting the populations in low- and middle-income countries particularly hard as 93% of the fatalities can be found in these countries (UNECE 2019). With projections of even higher numbers of road traffic deaths in upcoming years, particularly in low- and middle-income countries, international organizations, individual countries, and city administrations all over the world have acknowledged the need for action. Legal frameworks and guidelines have been in place for many decades, but the process of creating global policies, programs, and institutions has been significantly slower. Many of the conventions and legal provisions in place, such as the Geneva Convention for road traffic from 1949, have helped not only governments but also private companies to conform to global standards, and these legal guidelines have been a solid foundation for further progress. These conventions have mainly been under the supervision of the United Nations Economic Commission for Europe (UNECE). Despite a growing number of agreements, the progress concerning global policies, conventions, and resolutions for road safety was slow for a long period, and road safety was not a prioritized global policy area. This started to change, particularly during the late 1990s and early 2000s, and two important factors were the influx of resources leading to the collection of more data on traffic crashes and the publication of the World Report on road traffic injury prevention by the World Health Organization (WHO) in 2004. The same year, the WHO was invited by the United Nations to coordinate global road safety efforts, in close cooperation with the UN Regional Commissions, and one of the first actions related to that UN resolution was to establish the UN Road Safety Collaboration. After the adoption of the Decade of Action 2011–2020, the inclusion of road safety in several of the sustainable development goals in 2015 (road safety was not included in the millennium goals), and a number of ministerial conferences on road safety, it is fair to say that this policy area is established as one of the key development issues on the global agenda. On the other hand, millions of people still die every year in traffic crashes, and there is a growing demand for more concrete action.

Vision Zero, which is normally included into the family of safe system approaches, has received growing attention during the last two decades and is seen by many experts as a coherent policy program and even a policy innovation (Belin et al. 2012; Belin and Tillgren 2013; Kim et al. 2017). Vision Zero, as it will be described in this chapter, was developed in Sweden and adopted by the Swedish Parliament in 1997 (Swedish Government 1997; Swedish Parliament 1997a, b). The Swedish road safety work was already well established before the introduction of Vision Zero, but as the number of deaths in traffic crashes went down significantly after the introduction, many experts give credit to the systematic road safety work that Vision Zero enabled. In 2019, Sweden reported 2.1 deaths/100,000 population (Trafikanalys 2020) compared to approximately 18 deaths/100,000 population as a global average (WHO 2018). As the policy area of road safety grew increasingly global, actors within this field began to look at what was being done in countries like Sweden and the Netherlands but later on also in countries such as Australia and Norway who have all adopted similar, but also somewhat different, kinds of safe system approaches to road safety. Vision Zero is also inspiring and diffusing to other sectors in the society (Kristianssen et al. 2018). The progress made in these countries received global attention, and many organizations and individual experts were inspired by this approach, but there were also conflicts as the traditional views of road safety work differed quite considerably from that of the safe system approach (Salmon et al. 2012).

The purpose of this chapter is to map the role of Vision Zero in the development of global road safety policy. This is performed by studying the integration of Vision Zero in the road safety work and strategies of key international intergovernmental and nongovernmental organizations. The chapter also aims to account for possible opportunities and advantages of working with Vision Zero as a tool on the global level as well as the criticism towards the approach. A final purpose is to analyze whether Vision Zero has been transformed as a philosophy or policy program as it lands on the global level.

The main research questions are:

- What is the role of Vision Zero in global road safety policymaking?
- Do the key components of Vision Zero change when integrated in global policymaking?
- Why is Vision Zero seen as a promising approach and by whom?
- What are the challenges of working with Vision Zero on a global scale?

Why are these relevant questions to ask in relation to the development of global road safety policies? First, the global road safety policy process is an example of how global agenda-setting works and how actors in different capacities relate to a new idea. Second, it is important to scrutinize the strengths and weaknesses of new and inspiring ideas, particularly those who become role models for so many.

The chapter consists of six parts starting with this introduction. The second part addresses diffusion processes and how global agenda-setting is made. The methodological approaches are described in the third section followed by the presentation of the empirical material, i.e., the mapping of the role of Vision Zero in global road safety policy and the reflections on Vision Zero as a tool in practice. The fifth section contains an analysis, and the final part of the chapter is devoted to conclusions and a discussion about the significance of the diffusion of Vision Zero in conjunction with the global sustainable development goals as well as other implications for the future.

## How Do New Ideas and Policy Choices Enter and Consolidate on a Global Level?

Every global policymaking and agenda-setting process is unique in the sense that all policy areas have their own settings and preconditions, but there are also general discussions about mechanisms and factors related to policy change on the global level. The purpose of this section is to provide a theoretical foundation to the aspects of policy diffusion, global policy change, and global agenda-setting processes. These perspectives will help us to understand why some ideas become the base of new global policies and why other ideas are discarded. The theories can also provide an insight into the motives and roles of actors in the policymaking and agenda-setting processes.

### Global Policy Diffusion

Policy diffusion is a wide scientific field and relates to all societal levels, and research is performed with both quantitative large N studies as well as qualitative case studies. There are a number of empirical questions related to policy diffusion such as identifying actors, structures, methods, motives, timing, and content. Studies on how ideas travel between different contexts have been performed for decades, and we can, for instance, find inspiration in early research about imitation (Simmel 1904). Policy diffusion is a theoretical and empirical topic in many disciplines such as Political science, Public health, Technological disciplines, Human geography, Sociology, etc. Many researchers within this field depart from books such as Everett rogers' *diffusion of innovations* (1962). Rogers' theories, which have been developed in many revised editions, focus on the diffusion of new ideas and technological innovations and are based on four central dimensions: the innovation itself, how it is being communicated, temporal factors, and social system. According to Rogers, the innovation has to be adopted by a critical number of entities in order to be established and thus regarded as an innovation. The theories are based on an actor perspective and timeline, as the adopters are categorized as early adopters, early majority, late majority, and laggards (Rogers 1962). It is today more and more common to use new ideas, reforms, and innovations in the public sector, often seen as a part of the diffusion of new public Management, and these so-called policy innovations "*...offers a new definition of a political problem, provides a new political vision for the political community, and/or proposes a new set of political goals and strategies*" (Sørensen 2016:157). Inspired by the early research on diffusion, many influential studies have been published particularly within the field of political science (c.f. Berry and Berry 1990), and three subfields began to emerge: (1) policy diffusion, (2) policy transfer, and (3) policy learning. To learn from others is an intrinsic part of a lot of the policy development that is taking place, but it does not necessarily mean that policies are diffused or transferred. Research on policy diffusion have traditionally been more focused on structures, mechanisms, finding patterns, and explanations in predominantly quantitative studies (Gilardi 2016), while policy transfer relates more to actors, cases, and to follow processes rather than explaining them (Evans 2009). In attempts to create an overarching approach to both these subfields, various frameworks have been presented, such as the following model by Dolowitz and Marsh (1996, 2000) suggesting that there are seven ways to understand policy transfer: (1) Who is diffusing? (2) Why is a policy diffusing? (3) What is diffusing? (4) Are there degrees of diffusion? (5) What is the inspiration or original policy? (6) Are there factors limiting the diffusion? (7) Can the diffusion be connected to more successful policies? Several models such as this have mainly been used in a transnational or national setting. There are other examples of broader theories and models of explanation linked to global diffusion processes. These models often relate to mechanisms of diffusion, such as learning, imitation, coercion, and competition (Shipan and Volden 2008).

The international and global dimension is also prevalent in concepts such as bandwagoning (Ikenberry 1990), where states join other countries' policies for different reasons. It could be related to different kinds of alliances or that smaller countries adopt policies of bigger countries for political gains. In an international perspective, it is also relevant to talk about concepts such as policy translation or policy borrowing, as this is part of the ongoing process of creating global policies. Good examples are discussed and diffused in various circumstances, such as during international negotiations, conferences, and the like, and are at times incorporated into global policy documents. Finally, another key concept in the development of global policies is diffusion of ideas (c.f. Goldstein and Keohane 1993). This concept is often used in relation to specific arenas for diffusion, for instance, regional organizations such as the EU (Börzel and Risse 2009), and many studies have also focused on conscious strategies of diffusion (Stone 1999, 2012). The actors actively diffusing ideas are often called policy entrepreneurs and linked to global advocacy networks (Finnemore and Sikkink 1998; Keck and Sikkink 1999). They form knowledge-based groups often called epistemic communities (Haas 1992). We will return to these concepts later on, but we can already establish that Vision Zero is part of a diffusion process as countries and cities all over the world have adopted Vision Zero policy packages. In relation to these models mentioned above, the question is what kind of policy has diffused, why has it diffused, who diffuses, and under what circumstances?

## Global Policymaking and Agenda-Setting

What ends up as a prioritized issue on the global agenda is as stated based on many aspects, and it is quite complicated to ascertain whether and when a problem has become a global issue (Neveu and Surdez 2020). Political scientist David Held argues that there are three different ways for promoting issues and for changes to happen on the international level. First, actors and organizations within the civil society link with progressive or powerful governments and make a case together. Second, international institutions can by themselves adapt to a new situation or push an issue forward regardless of opinions on the domestic level. Third, powerful networks of actors are formed in order to influence a policy area either from the top or from below (Held 2017). These factors can help us understand the direction of the development of a certain policy area. But there are also other important preconditions, such as the availability of resources, information, and data, and of course the political will to make changes. Agenda-setting is related to power, and such a process also involves risks and challenges. Klaus Dodds (2005), a geopolitics researcher, provides four critical aspects of global agenda-setting. First of all, how do we know that the key actors are focusing on a relevant problem? Second, by creating a global network for a certain policy area, there is always a risk that some geographic areas or views are not represented and that some perspectives get lost on the way from the national to the global level. A third concern is the incentives and motives of the actors involved in shaping the agenda. There is always a risk that powerful actors set the agenda in a way that creates division instead of global unity. Fourth, international relations are based on voluntary cooperation, and it is a dire task to argue with and convince skeptical actors to participate in certain governance structures such as international conventions and the like, which makes the jurisdiction of the decisions made a constant subject for discussion (Dodds 2005). Challenges apart, actors will not seize to promote issues on the global level that they find important, and it is particularly relevant to understand not only agenda-setting and policy change but rather the mechanisms related to deeper institutionalization processes, which require a more profound change of global structures.

## Global Advocacy

To answer the questions raised in this chapter, we also need to understand the role of actors more specifically. Here, two perspectives will be used: transnational advocacy networks (TANs) (Keck and Sikkink 1998, 2014) and the advocacy coalition framework (ACF) (Sabatier 1998; Sabatier and Weible 2007). The seminal work by Keck and Sikkink from 1998 established the concept of transnational advocacy networks which has been used widely to describe both loose and more formal collaboration between various actors working on a global level on a specific issue sharing basic values. These networks are based on "the centrality of values or principled ideas, the belief that individuals can make a difference, the creative use of information, and the employment by nongovernmental actors of sophisticated political strategies in targeting their campaigns" (Keck and Sikkink 1998). The TAN concept is focusing mainly on the work of NGOs, and the network actively promoting road safety on the international level is broader. Therefore, we need to acknowledge that these global networks can also contain various actors from many institutions. The Advocacy Coalition Framework (ACF), as presented by Sabatier, views policy change as either caused by external shocks or a more long-term negotiation, that all participants in the coalition or network share a common belief system, and that there is a high degree of learning between the participants (Sabatier and Weible 2007). This can be related to the earlier mentioned epistemic communities. Although ACF has primarily been intended for contexts where there are competing coalitions, it will be an open empirical question in this chapter whether there are such constraints within the policy area of road safety. This brief introduction to theories on diffusion, global policymaking, and agenda-setting does not presume to be all-encompassing but helps us to understand what happens when new ideas are introduced on the global level. The focus is both on the content of the new idea and on the actors actively promoting or discarding this idea. Was Vision Zero actively promoted, or was it part of a more traditional policy borrowing process? Being a new idea, was the introduction of Vision Zero a conflictual process?

## Global Road Safety Policymaking Research

Although there is plenty of road safety research with a global or transnational perspective specifically targeting different aspects such as road assessment, speed management, vehicle safety, traffic crashes, etc., not a lot has been written about global road safety policymaking. Research on road safety tends to focus more on the national level and local examples, although policy-related research about road safety is scarce also on those levels. The existing research on global road safety policymaking focuses mainly on two perspectives, concrete policies and/or measures often related to specific global commitments, and more actor-centered studies. As an example, there is research following the progress made in relation to the pillars of the Decade of Action. Hyder et al. (2017) conclude that a lot of progress has been made in terms of systematic efforts on all levels to decrease the number of deaths but that it is still difficult to measure progress. There is need for more data and above all better data. An example of policy-related research is the set of literature on road safety philosophy mainly those writing about safe system approaches (c.f. Larsson et al. 2010; Hughes et al. 2015). The existing literature on safe system approaches recognizes both the ability of this approach to be used in global and national road safety contexts and also that existing safe system models can be further modified. There is both a possibility to learn from other sectors and from within the road safety sector. Turning to studies with a focus on actors within the road safety sector, McIllroy et al. (2019) have performed an interesting mapping of the influence of road safety actors at various levels as well as their interaction. This is a particularly interesting study as it gives a vivid image of the system and clearly visualizes both the potentials and challenges. When actors are intertwined in a system, there are opportunities for single actions to have effect in the larger system under certain circumstances, but the study also makes it clear that it is more likely that actions directed only towards one topic will divert the attention from the broader picture. There is also literature offering a helicopter perspective on road safety looking both at the historical development of road safety thinking (Hakkert and Gitelman 2014) and forward-looking approaches (Wegman 2017). This brief summary of research on global road safety policymaking shows that we need to know more about the role of global road safety strategies and policies in the overall road safety system.

## Research Design

The content of this chapter is based on a research project mapping global road safety policy and governance. The project is financed by the Swedish Transport Administration, and one part of the project relates to the role of Vision Zero in global road safety policymaking. The empirical material consists of policy documents, such as reports, resolutions, visions, and other kinds of statements from key intergovernmental organizations, such as the United Nations and its regional commissions, the WHO, the World Bank, and the OECD. The documents from intergovernmental organizations (IGOs) have been studied using a qualitative content analysis where sections on Vision Zero and the related concept safe system have been selected for deeper analysis. These texts are scrutinized in order to find key components of Vision Zero. These key components used for the analysis can be found under section "The Vision Zero Policy in Global Road Safety Policymaking." Other sections of the texts have also been read as a way to analyze whether Vision Zero components have been used while not using the terms Vision Zero and Safe system. Statements and reports from nongovernmental organizations (NGOs) have been analyzed in order to identify whether there are alternative perspectives on the role of Vision Zero.

In addition, the chapter is based on an interview study with 29 respondents from various IGOs, NGOs, and research organizations working with road safety. The interviews were performed in 2017–2018. The selection process is based on finding senior experts within the field of road safety, and the criteria are that they are or have been working for intergovernmental organizations or nongovernmental organizations. The respondents also include researchers with an expertise covering global road safety issues and experience in cooperating with various kinds of international organizations and institutes. The interviews are semi-structured and have all been transcribed word by word. The interviews were made equally on online platforms, face to face, and over telephone. The respondents are anonymous and coded according to the following: intergovernmental organizations (IGO 1, 2, 3, etc.), nongovernmental organizations (NGO 1, 2, 3, etc.), and researchers (research 1, 2, 3, etc.). The respondents have in almost all cases a broad background, often starting their careers on the national level, and a majority of them have been working for several kinds of international organizations. The respondents have been selected based on two parameters: their current affiliation where they are asked to talk about the discussion and work of their organization and the unique expertise in this field where they are also asked to reflect more personally on the development of global road safety policies. In order to find these senior experts, a snowballing approach has been used, where the respondents have been asked to name other experts who both agree and disagree with their position. This has been complemented by direct contacts with specific organization. The questions asked concerned the following topics:

- The role of Vision Zero in the global road safety policy documents
- The role of Vision Zero in the global formal and informal discussions concerning road safety
- The advantages of working with the Vision Zero policy
- The challenges of understanding as well as implementing Vision Zero
- The past and current road safety philosophies
- The implementation of Vision Zero in relation to the specific challenges of low- and middle-income countries

## Vision Zero in Global Road Safety Policymaking

In order to understand the role of Vision Zero in global road safety policy, we will first identify the main events in this development process concentrating on the last two decades. As mentioned earlier, there have been existing guidelines and regulations for road traffic ever since transportation systems were established. These regulations, such as the Geneva Convention from 1949 (United Nations 1949) and the Vienna Convention from United Nations 1968, have mainly been supervised by the UN Economic Commission for Europe (UNECE) and are today under the supervising umbrella of a number of work packages. The temporal focus of this chapter is from the late 1990s up until 2020, mainly because of the establishment of Vision in the later part of the 1990s, but also due to the fact that we have during these last 20 years witnessed a consolidation of road safety as a global policy area. Before this period, many actors regarded this policy area as falling mainly within the national interest sphere. This was also a period where new organizations were established promoting road safety, such as the World Bank-sponsored Global Road Safety Partnerships (GRSP) established in 1999 and hosted by the International Federation of Red Cross and the Red Crescent Societies. The question is what made road safety a *global* problem besides being an evident national and local issue? Both the respondents in this study and the documents point to an increasing and more systematic collection of solid data as a key reason for the growing global interest in road safety. This began already in the 1990s, and one such process was a collaboration between the World Health Organization (WHO) and the World Bank. This process of data collection and bringing road safety to global attention was also backed by individual countries, aid organizations, and later on by other IGOs and NGOs. This data collection process led to the publication of the influential *World Report on Road Traffic Injury Prevention* (WHO 2004). Although this was not in any way the first attempt to frame and form global road safety as shown earlier in this handbook, this report was for many an important turning point for global road safety measures as it so clearly identified the basic problem; millions of people are dying each year in traffic crashes. The same year, the United Nations adopted a resolution (United Nations 2004 UNRES 58/289) inviting the WHO to be the coordinator for road safety within the UN system. The same resolution also called for the WHO to cooperate closely with the UN Regional Commissions in this capacity. As the resolution also named the World Bank as a key actor, it broadened the interpretation of how the coordination would be structured. When accepting this coordinating role, the WHO, in close cooperation with the UN Regional Commissions, established the UN Road Safety Collaboration (UNRSC) in 2004. The first high-level ministerial meeting on road safety took place in Moscow in 2009, and it was followed the same year by the UN declaration of the Decade of Action for Road Safety, 2011–2020. Specific programs were set up to monitor the progress related to the pillars of the Decade of Action (Hyder et al. 2017). During this decade, many NGOs established programs for road safety, and some of the most influential have been the FIA Foundation, the Bloomberg Philanthropies, the Global Alliance of NGOs for Road Safety, specific road assessment programs such as iRAP, car assessment programs such as Global NCAP, several victim's organizations, etc. The second global ministerial meeting took place in Brasilia in 2015, a global envoy for road safety was established at the UNECE the same year, and in 2015, the sustainable development goals (SDGs) were adopted, where road safety was explicitly included. From not being mentioned in the millennium goals to being included in the SDGs in relation to both health and transport has already made a big difference worldwide. The consolidation and institutionalization of road safety as a global issue has continued with the establishment of the UN Road Safety Trust Fund (United Nations 2018) placed at the UNECE and the third Global Ministerial Conference in Stockholm in 2020. The recommendations presented at the conference have since then been endorsed by the United Nations (United Nations 2020). The question asked in this chapter is if specific road safety philosophies can be discerned in this process and particularly Vision Zero.

## The Vision Zero Policy in Global Road Safety Policymaking

Before identifying the role of Vision Zero in global road safety policy, it is important to create a common point of departure as to what Vision Zero is. This is naturally mentioned in many chapters in this handbook, so this is a brief recap based on Belin et al. (2012). First of all, the problem to be solved is that people die and are seriously injured in the road traffic system, not that accidents occur. The problem is also that the system is not built to handle human mistakes. Humans will always make mistakes, and if the system is adapted to this precondition, crashes are preventable. The ultimate responsibility thus falls on the system designer, not the individual road user. The assumption must also be that nobody wants to die, everyone wants safety. There is therefore no optimum number of deaths in relation to cost. Finally, the goal must consequently be to eliminate fatalities and serious injuries. In addition to this definition, the Swedish Vision Zero is based on a scientific foundation both in relation to human tolerance to violence and how policies and measures are adopted. Vision Zero furthermore adds a long-term perspective on road safety based on a management by objectives, and the vision is grounded in a system of actors where everybody is responsible for its part in the road safety system, ideally a kind of network governance with one clear lead agency.

After the adoption of safe system approaches in a number of countries, particularly Western European countries such as Sweden and the Netherlands (Larsson et al. 2010), the ideas quickly became part of the ongoing discussions in various intergovernmental organizations and collaborations mentioned partly above. The dominating approach to working with road safety up until then can be illustrated by the three Es: education, engineering, and enforcement (c.f. McIllroy et al. 2019). The Swedish Vision Zero has a different approach as already concluded in this handbook as to its ethical approach, scientific foundation, comprehensive or systemic perspective, long-term management by objectives, and its view on shared responsibility and shared safety interest. As the Swedish Vision Zero was adopted in 1997, it is important to remember that the policy has naturally gone through changes and updates over the years.

The pioneering report from the WHO and the World Bank in 2004 introduced the safe system approach to a larger global audience and labelled it as a requirement to work with safety in the complex transport system because there is a need for:

> . . .understanding the system as a whole and the interaction between its elements [. . .] In particular, it requires recognition that the human body is highly vulnerable to injury and that humans make mistakes. A safe road traffic system is one that accommodates and compensates for human vulnerability and fallibility. (WHO 2004:157)

The description of the Swedish Vision Zero is given space in the report and described in the following terms:

> Vision Zero in Sweden and the sustainable safety programme in the Netherlands are examples of good practice in road safety. (WHO 2004:158)

The WHO has continued to produce Global Status reports on road safety, and Sweden is often used as a successful example. The WHO has followed the continued updates in measures and policies in the Swedish road safety strategies.

> Experience in Sweden illustrates how better results can be achieved through long-term, perennial planning of systematic, evidence-based approaches to intervention, supported by a strong institutional delivery including leadership, sustained investment and a focus on achieving ambitious road safety goals and targets across government, business and civil society. (WHO 2018:20)

Vision Zero and safe system approaches were also recognized by other organizations during the 2000s, such as in the report from OECD and the International Transport Forum, published in 2008, which is a collaboration with representatives from individual countries and NGOs. This report is mentioned by other organizations and by the respondents in this study as a key in both knowledge development and the diffusion of the approach. One of the key aspects of the report is that:

> It describes how a Safe System approach can re-frame the ways in which safety is viewed and managed. (OECD/ITF 2008)

The report argues that the safe system approach, and Vision Zero as an example of it, constitutes a groundbreaking shift in how to work with road safety. The OECD/ITF has contributed to produce reports containing country evaluations (OECD/ITF/IRTAD 2016) and other assessment reports focusing on the role of safe systems. A report from the OECD/ITF from 2016 refers specifically to the process of introducing the safe system approach as a paradigm shift (OECD/ITF 2016).

The Moscow Declaration, which came out of the first global ministerial meeting in Moscow on road safety, acknowledged both the 2004 report from the WHO and the 2008 report from OECD/ITF urging countries to adopt a safe system approach. More importantly perhaps from a global perspective was the call for a decade of action. The Decade of Action for road safety 2011–2020 was declared by the United Nations in March 2010 (United Nations 2010) and contains five pillars focusing on safe roads, safe mobility, safe vehicles, safe drivers, and post-crash response. The global plan for the Decade of Action is based on a safe system approach and provides guidelines as well as urging countries to prepare their own road safety plans in accordance with the pillars. The safe system approach related to the global plan includes the acceptance of human errors, the production of infrastructure and vehicles in direct relation to the limitations of the human body, and shared responsibility (WHO 2010). The UN Road Safety Collaboration, hosted by the WHO, is working actively with its members to find productive ways to work with the pillars, and one has been to promote safety targets and another to base the pillars on a safe system approach. A recent UNRSC report states that:

> Integrated with safe system action across all pillars will ensure the global fatality and serious injury reduction targets are met by 2030. (UNRSC 2020)

The United Nations works on various fronts when it comes to road safety. The Global Forum for Road Safety (formerly WP.1) hosted by the UNECE is overseeing the global regulatory work concerning road safety described in its own plan for the Decade of Action (UNECE 2010; UNECE 2012) its integration of a safe system approach into the legal instruments. The UNECE also gives space to introducing new ways to work with regulations and presents in several ways the Swedish long-term method of working with management by objectives. The UNECE also hosts the UN Special Envoy for Road Safety, currently Jean Todt, and the role of the special envoy is to mobilize political support, to raise awareness about the work of the UN, to do advocacy work and alleviate partnerships, and to showcase good practice (UNECE 2015, terms of reference). Working for the United Nations, the special envoy's role is to promote the UN agenda (which we can now conclude promote a safe system approach) but also to call for action, which he did in the foremath of the latest high-level ministerial meeting:

> Road crashes on the alarming scale we witness today are not accidents. They are the failure of a system which does not sufficiently value safety. This is why we need a new paradigm for road safety that focuses on building a safe system. (UNECE 2020)

Although Vision Zero and safe system approaches are diffusing to all continents of the world, the other UN regional economic commissions such as UNECA, UNECLAC, UNESCWA, and UNESCAP are particularly highlighting the challenges faced by low- and middle-income countries when it comes to road safety measures. For instance, the African Road Safety Action Plan linked to the Decade of Action states that:

> The Decade of Action will provide the opportunity for African countries to intensify or to develop activities towards building their institutional capacity. Countries that have made more progress in putting in place structures and processes to improve road safety can focus on more advanced targets, such as capacity building at local government level, and developing local research and road safety monitoring. (UNECA 2011)

It is a valid discussion as to whether certain institutional, political, and civic preconditions have to be met in order to fully apply a safe system approach. When studying documents also from other UN Regional Commissions, the focus in the information on road safety is generally on more specific road safety problems disproportionately bestowed upon low- and middle-income countries and not on global road safety philosophies, although there are exceptions such as in this report by the UN commission for Asia and the Pacific:

> Speed management measures should be consistent with the global "Safe System" approach to road safety: road designers, builders and managers must take into account the known limits of the human body. (UNESCAP 2019:14–15)

The World Bank has together with a number of actors, such as the Global Road Safety Partnership (GRSP) hosted by the Red Cross, worked with road safety in cooperation with low- and middle-income countries. The World Bank supports the safe system approach as stated in a report by the Global Road Safety Facility (GRSF) hosted by the World Bank:

> The globally accepted best-practice approach to addressing the road safety crisis is the Safe System approach. (World Bank/GRSF 2020:6)

There is an awareness of the specific problems in low- and middle-income countries, but in a report written in collaboration with the World Resources Institute (WRI) supported by the Bloomberg Philanthropies and the FIA Foundation, the safe system approach and Swedish Vision Zero (termed the best-known brand of the safe system approach) are described as universal approaches.

> With the policy concept spreading, caution needs to be taken to ensure that all the features of a Safe System approach are evident in each new context. Although the distinct needs and opportunities in each location require unique strategies for action; the principles, core elements, and key action areas of a Safe System remain conceptually universal and interrelated. (World Bank/WRI 2018:13)

The second global ministerial meeting on road safety, held in Brasilia in 2015, was focused on the inclusion of road safety in the global sustainable development goals (SDGs), and among other perspectives, the Brasilia Declaration (2015) encourages the use of road safety targets in order to reach the goals. In order to find tools to work with the SDGs, several actions were taken such as the establishment of the UN Trust Fund for road safety in 2018 following a UN resolution (UNECE 2018; UN 2016, resolution 70/260). The global strategies for the trust fund specifically mentioned the safe system approach in Sweden and the Netherlands.

> This approach takes into account human failings and requires that not only the users are responsible for complying with traffic rules but that joint responsibility is borne also by all actors involved in design, construction, maintenance and improvements of roads and vehicles as well as organisation of post-crash response so as to ensure highest road safety performance. (UNECE 2018)

The third global ministerial meeting on road safety took place in Stockholm in 2020, and the Stockholm Declaration (2020) emphasized the safe system and Vision Zero approach in several sections such as:

> Encourage Member States that have not yet done so to [. . .] ensure that legislation and standards for road design and construction, vehicles, and road use are consistent with safe system principles. (Stockholm Declaration 2020:3)

The declaration also encouraged the private sectors to use safe system principles in their whole value chain and furthermore highlighted “the need for an integrated approach to road safety such as safe system and Vision Zero” (Stockholm Declaration 2020:2). The Stockholm Declaration was endorsed by the United Nations in August 2020 (United Nations 2020).

We have seen through this presentation how the safe system approach and the Swedish Vision Zero as the key example have become part of the strategies and visions of the major intergovernmental organizations working with road safety. It is also clear that there is a partnership between many of these organizations and NGOs providing both resources and projects in line with the global strategies. The advocacy work of organizations such as the FIA, the FIA Foundation, Bloomberg Philanthropies, World Resources Institute, the Global Alliance of NGOs for Road Safety, the Global Road Safety Partnership, and many more has helped diffusing texts and projects promoting a safe system approach and Vision Zero although focusing primarily on "getting things done." The challenge when using a safe system approach and Vision Zero is to get the right things done. The question is whether these commitments stated above to a safe system approach have been or can be transformed into workable tools on the global level. It would first of all require a common comprehension and knowledge on what a safe system approach is and Vision Zero in particular. The question is also whether these approaches can also be tools when working with road safety in a low- and middle-income context or are these perspectives made for countries with all the "right" institutions, political systems, and civil societies in place?

## Safe System and Vision Zero in Practice

As in many other policy areas, strategies and visions have to be transformed into concrete projects and measures in practice. In this process, individuals and groups establishing these strategies as well as implementing them face all kinds of challenges. This section contains a description of how senior experts in the field of road safety analyze the role of Vision Zero and safe system approaches on the global level primarily, but they also address the link between the global and the national level. Why is it important to study what 29 senior experts have to say about Vision Zero? First of all, these experts are part in forming and framing the global agenda on road safety, and what they base their work on is relevant for the outcome. Second, the selected experts have a long experience working within this field, which makes their analyses grounded and insightful as to the role of various road safety philosophies and strategies, although they do not always agree with each other. Third, as the experts work with different instruments, in a variety of organizations, and with specific areas of expertise, they form a micro society for road safety issues.

### A Paradigm Shift in Road Safety Philosophy?

Policymaking is often easier when there is a group of people sharing the same understanding of the world, so-called belief system (Sabatier and Weible 2007), the same problem definition, and similar sets of solutions to these problems. Many of the respondents in this study are saying that there is a need for a common understanding of road safety problems in order to find the right solutions, but not all agree that it is crucial that everyone shares a common road safety philosophy. The respondents paint a picture of two parallel road safety philosophies: the traditional view that the problem concerning road safety is primarily the behavior of the road user which causes serious injuries and deaths and the safe system approach where there is basic view that human beings make mistakes and that we have to construct a system that allows for these mistakes. The overall opinion among the respondents is that both these philosophies exist parallel to each other. There are many experts working with road safety that still believe that the behavior of the road user can be considerably altered leading to fewer deaths, but that deaths cannot be avoided completely. Others are convinced that deaths can be prevented and that the transport system can be constructed in a safe way. The study on which this chapter is based shows that there are three perspectives regarding road safety philosophy and a potential paradigm shift. First, a minority of the respondents claim that the traditional view still prevails as the leading global road safety philosophy and that the introduction of the safe system approach has led to interesting discussions but has not changed road safety work in practice. These respondents claim that this is evident when focusing on the national level.

> I'd say that the majority of the road safety community is still working to the old approach, and the safe system approach is becoming increasingly recognized, but it still hasn't made it beyond the sort of small group of enthusiasts into the wider community. (NGO 1)
>
> First, I am not sure that it is a package that is well understood by all so there are still in several countries [. . .] a kind of skepticism about safe systems. (IGO 3)

A second group of respondents argue that the safe system approach is the dominant global road safety philosophy today, but that it has not changed road safety work on the ground yet. They claim that the safe system approach is constantly gaining ground although it is a slow process and that the approach might be seen as a bit too complicated and theoretical.

> I think definitely that the safe system has taken a long time to manifest itself and grasp people. [. . .] I mean really, again, there is a lot of people who work on theoretical level. I mean if you look at the world and who are the thinkers and who are the implementers, there are many more people who have it in their head than actually doing it on the ground. (NGO 8)
>
> There is a growing consensus around Vision Zero kind of approaches and particularly if we talk about safe systems and the number of sort of landmark reports that have led to that [. . .]. It really embraced a lot of these things and so it is almost a consensus now. Not entirely, but it is almost consensus. (NGO 9)

Others also argue that there is a limit to the usefulness of more theoretical approaches as you need to understand each and every context in order to make a difference. The argument is that enough has been said on an abstract level, now is the time for action.

The third group of respondents is those who claim that there has been a significant shift and that the safe system approach is the leading road safety philosophy today. This is especially highlighted in relation to the global scale and in the work of intergovernmental organizations. These respondents argue that we are witnessing a paradigm shift, significantly altering the way road safety is viewed in terms of problem formulation as well as solutions.

. . .overall there is a good understanding about the need for an integrated approach. So the philosophies or the ideas are more in tune than in conflict. (IGO 2)

Most respondents view the "conflict" between a traditional road safety approach and the safe system perspective as problematic in terms of hindering organizations to work effectively with road safety on a global scale, while others do not.

Safe System is not that kind of prevailing philosophy, despite the fact that everyone is talking about it. I don't particularly see one paradigm in the world. But I think it is a good thing that there is no one paradigm, because one recipe would never ever work. (IGO 1)

### The Role of Vision Zero in Global Road Safety Policymaking

All respondents in the study recognize that the Swedish Vision Zero is a leading safe system approach, and as such it is visible in all global road safety discussions. The question here is whether Vision Zero is portrayed in a similar way whenever used, and another question is whether the perspective is recognized on other levels than the global. First of all, the presentation of safe system approaches as portrayed in global policy documents shows that there is a quite coherent image of the approach, but we start seeing different ways of using the concept when looking at the material from some NGOs, specific implementation processes on a national level, and how the perspective is interpreted by cities ready to launch a Vision Zero, for example. This is where we start to see major differences in how key terms are interpreted. This is particularly clear when it comes to road user behavior and enforcement. Several respondents are praising the ambition of Vision Zero but argue that it is difficult for some actors to turn it into a workable tool.

Vision Zero has a big role and we can't justify anything else, of course not. It is what it is all about and that is what it should all be but I think it is still coming across as a very sophisticated western idea and people don't understand why we need another role and it is yet another buzzword. (NGO 8)

Many of the respondents, convinced that the safe system approach is the way forward, are also aware of the difficulties of translating the philosophy to all levels as well as political and geographical preconditions. There is thus a significant difference in how Vision Zero is recognized on different levels.

I would describe it as the leading light within the international community, but I'd also describe it as a policy that people don't understand or haven't traditionally understood well, but I still believe that it has great potential. (NGO 3)

I think one of the problems though is that there is a gap between the countries and governments that really understand what it means and then some countries and governments and other stakeholders are still make a rather simplistic analysis. I find very often when you talk particularly to politicians who have lots of competing pressures on their lives and they have got a lot of demands that they need to satisfy. They will all reach for very simple solutions. (NGO 9)

The respondents are also to some extent reflecting upon whether it is actually the exact content of Vision Zero that is seen as a promising policy or if Vision Zero represents one way of having a systematic approach to road safety. Therefore, it is an interesting discussion whether countries in dire need of lowering the number of deaths should start working according to a safe system approach or if they should start by establishing systematic road safety strategy, perhaps with one specific area at a time, eventually adopting a full Vision Zero.

> . . .they [a systematic approach vs. Vision Zero specifically] work along each other. They are complementary to each other, but the plan is to having moved [. . .] your road safety capacity, move it to a higher level of operations. So that is the plan. That may mean concentrating on one or two specific areas first more than others. That doesn't mean you give up the idea of zero fatalities, but it is an operational plan and I always saw Vision Zero from a philosophical term. It is part philosophy, part operational and I think it is a hell of a great philosophy. We don't have a better kind of philosophy right now. (IGO 4)

### The Advantages of Vision Zero

It is evident that many of the senior experts interviewed for this study acknowledge both the growing role of Vision Zero and also the challenges of introducing new ideas on a global scale. So what are the advantages of Vision Zero, or rather what are the features that make this policy diffuse all over the world? The study identifies at least five "attractive" features.

First of all, the zero approach is presenting something new and unusual, something inspirational going beyond what anyone thought would be possible. Once you start talking about zero, many of the experts argue that there is really no way back. This ethically based argument has, for instance, also been seen in campaigns for safe system approaches.

Second, it provides a whole comprehensive policy program, which makes it a more holistic and systematic approach. It involves all kinds of actors and organizations. Related to this is the notion of shared responsibility but also that the responsibility ultimately falls back on the system designer.

Third, the way Sweden managed to lower its number of deaths and serious injuries is seen as a great inspiration.

> . . .we can build on your experiences and see how safe system has been implemented in practice, what it means. So it starts to become something tangible, that you can observe, that you describe. . . (IGO 3)

But the inspiration also comes from the "story" of Sweden itself and how Vision Zero fits into the political and cultural dimension.

> I think Vision Zero has been the most marketable [. . .] in terms of having ambitious targets you know it is the Swedish model [. . .] it is not just the story of what Vision Zero is, it is a political story and how Sweden came to accept certain interventions such as the 2+1 roads [. . .] So I think the sort of cultural aspects of Vision Zero are very valuable. . . (IGO 4)

The fourth aspect pointed out as a positive feature is that Vision Zero is a long-term strategy and not a short-term slogan (even though it is a catchy phrase). This means that you are getting a full policy program but that you have to be patient and persistent. Therefore, you also need political support.

> Part of that dynamic is that is, I think it always makes you look forward. You always sort of think well what is coming next. What is the technology that I could use and you will always face new bottle-necks or new problems that come up on the horizon. (NGO 9)

The fifth view of Vision Zero is that it is perceived as based on facts, data, and science. This concerns both the way Sweden works with management by objectives based on a continuous data collection and traffic crash data.

### The Challenges of Vision Zero

On the other hand, the respondents also point to a number of challenges concerning Vision Zero and its implementation in relation to the positive aspects mentioned above. First of all, the zero approach could be regarded as an unrealistic target and also naïve. This pertains in particular to a criticism that Vision Zero is a policy for high-income countries and is more challenging to implement in low- and middle-income countries. And it is at the same time in that context that improvement is mostly needed.

> I think the countries in our region, they are not there yet because we are so far from zero so it is very helpful to have this at the horizon saying that no loss of human lives is acceptable for you know in this area but at this point I think if we could just cut them by half, the road safety accidents in our region, that would have been a tremendous progress. That being said, I think, well I know that the idea of vision zero is very useful in a sense that it shows how road safety is something that can be overcome. (IGO 9)

Sweden and several other countries using a Vision Zero approach have seen considerable improvement over the years as we have discussed, but the respondents also point to the uniqueness of these countries. They are all wealthy countries with an opportunity to invest, not only in monetary terms but also in ethics. Not all countries have democratic regimes, and many face other problems.

> ...the usual argument is that Sweden is very wealthy and it's a small country when it comes to population and it's manageable, and there is a lot of law-abiding citizens and the issue of ethics, and not economics, is something that goes well with the Swedes, okay, part of your psyche, or part of your fabric, so the issue of how replicable the Safe System Approach is, not only for places in Europe, you know, Germany or Poland or Russia, but to Congo, or to South Africa, okay. This is when all of this, it breaks down. (IGO 1)

We have already concluded in an earlier section that although Vision Zero presents a full policy program, it is still difficult to understand. It is also complicated to identify what is part of a system. Therefore, there might be countries saying that they implement Vision Zero but they do not grasp the approach to the full.

> I think that there are some very good elements in the Safe System Approach, but the issue, you know, the evidence is that nobody else is doing it, despite the fact that many countries are actually saying that they are doing it… (IGO 1)

Finally, and in relation to the transparency of Vision Zero and the ability to understand its features, the approach is by some respondents seen as too academic and too theoretical but also that it takes energy and resources to translate the vision so that it both fits and can be accepted in all kinds of contexts. Some countries have less time to spend on being patient and wait for the long-term results and are more eager to find policies that can be implemented right away leading to positive short-term effects.

> I think the safe system and all these things are connected and we are definitely supporting the ideas, but I still think that our role is really the implementation and I think translating Vision Zero and the safe systems down to that, it would require some work that might, should might be better spent on implementation. (NGO 8)

## Analysis

Looking at the development of global road safety policies, there is no doubt that the safe system approach and Vision Zero play a significant role, the very least as an inspiration. It is undoubtedly a new, inspiring, and for some actors a quite provocative way of thinking. Looking at the selection of the policy documents, there seems to be more or less a consensus that safe system approach is the way forward in road safety policy. The interviews, on the other hand, show that policy implementation is not that simple, nor is the complete change in safety culture that Vision Zero requires in many contexts. This section returns to the theoretical perspectives on diffusion presented earlier and presents a short analysis of the role of Vision Zero in global road safety policymaking.

### What Vision Zero Is Diffusing?

The first question scrutinized in this analysis is if we are observing the diffusion of a coherent road safety policy program or philosophy or if there are several alternative interpretations. In other words *what* is being diffused? Looking at the various documents from intergovernmental organizations, there seem to be a consensus on what a Vision Zero is. The explanation, in some cases, is that the texts have been produced in close cooperation with Swedish authorities or Swedish experts, but the coherence is evident even in other documents. The conclusion is that there is an awareness of what Vision Zero is on a global policymaking scale. When looking at materials from NGOs and the arguments raised in the interviews, the understanding of the content of Vision Zero and safe system approaches is more varied. Some organizations are strong advocates for a safe system approach, but they are simultaneously writing about campaigns directed at educating the driver. These perspectives do not go well together. The respondents in this study point to complexities in understanding safe system approaches and that there are cases where Vision Zero in particular has been used as a catchy slogan but where the content is more related to a traditional road safety philosophy.

## Why Is Vision Zero Diffusing?

The groundbreaking report from the WHO in 2004 was one of the first global road safety documents grounded in solid data. Together with other similar reports and documents, it helped identifying deaths in the road traffic system as one of the major causes of deaths, particularly in low- and middle-income countries. The fact that the WHO is the lead agency also framed road safety as a public health issue. All these development prompted intergovernmental organizations to adopt new ways of working with road safety, as we have discussed earlier in the chapter, and it opened a window of opportunity (Kingdon 1984) for Vision Zero and other safe system approaches to offer a new kind of policy but also a completely new way to assess the problem. Another explanation is related to the presentation in the last section on the "attractiveness" of Vision Zero. It is generally regarded as a new interesting policy program, which has also been tested successfully in various contexts.

## Who Diffuses Vision Zero?

When analyzing the interview material, it becomes quite clear that the voices promoting the Vision Zero approach belong to a global or transnational advocacy network. It is not a formal network, but many of the experts in this study know each other or know of each other. Many of them share the same belief system and form a sort of epistemic community, where their philosophical point of departure is the safe system approach and particularly Vision Zero as the leading policy. Therefore, it has been important to broaden the number of respondents to make sure that alternative voices are included. Using solely the snowballing method of selection would have led to a more one-sided result. This network consists of experts from NGOs, from intergovernmental organizations, from research, and from national governments, and using Held's categorization, this network has helped pushing Vision Zero and safe system approaches onto the global road safety agenda. It has been a process where the NGOs have been particularly successful in forming alliances with key intergovernmental organizations to make sure that certain issues of road safety are emphasized. These actors can also be described as policy entrepreneurs (Mintrom and Norman 2009) using several arenas to promote their ideas.

## How Is Vision Zero Diffusing?

The policy entrepreneurs are, in this case, actors deliberately diffusing Vision Zero as a policy program, but there are also more organic processes of policy learning and policy translation. When a country is making progress in a complicated policy area with many actors involved and with lives on the line, other countries naturally tend to look at this particular success story asking what can be learned from that process. If a country or city attempt to copy a policy, it is rarely without complications. Instead, you often find that there is a translation process to adapt the policy to the context. Vision Zero is definitely diffusing in that way as we speak, but as this chapter is focusing on the global level, we can see how Vision Zero is presented to a wide global audience in the global policy documents, and the inclusion of the vision into these policy documents is part of the diffusion process. Vision Zero is also diffused at global conferences and seminars of different kinds. Representatives from countries that have adopted Vision Zero or other safe system approaches are often invited to share their knowledge in other contexts.

## Conclusions and Discussion

We can conclude that Vision Zero plays a significant role in global road safety policies and that the introduction of the vision has led to a shift in the work mode from a traditional behavioral approach towards a system's approach. But in order to conclude that shift, there are several steps to be taken. Although it is evident that Vision Zero has inspired many intergovernmental organizations as well as NGOs, there is still an ongoing process of implementing this approach in many different contexts. Evaluations of these attempts will determine whether Vision Zero is a vision for everyone or has to be transformed in order to fit various kinds of contexts. This is especially challenging in relation to low- and middle-income countries.

The material analyzed in this study shows that the key components of Vision Zero remain intact in the writings from the intergovernmental organizations. Interpretations and transformations take place on other arenas and other levels.

Vision Zero is seen as a promising approach for many reasons, and one obvious factor is the success of the policy in many countries. It is being regarded as best practice which is exemplified, for instance, in the chapter in this handbook. Another reason is that it can be interpreted as a policy program or package ready to be used, and a third is that the ethical core is viewed by many as the only way forward.

There are challenges when introducing new ideas onto the agenda, and one of those is that certain models or programs are viewed as miracle methods and are introduced too quickly and/or too disorganized. It is therefore essential to see this process going on in global road safety policy with a little bit of caution and as a process of continuous development and transformation. It is also important not to abandon what might be successful processes or policies already in place. The old is not necessarily all bad, and the new is not necessarily all good.

It is important to recognize that there is a huge difference concerning the point of departure for high-income countries and for low- and middle-income countries. Therefore, it is crucial to add a question to the analysis of the diffusion process – where is the diffusion taking place? The difference in preconditions is also relevant in relation to the direction in which countries can go.

> Countries with a mature road safety approach [. . .] are expected to move in the direction of a Safe System approach. [. . .] Many low- and middle-income countries (LMIC) face a different starting point. Reports indicate that there is a lack of almost everything: a lack of leadership, a lack of political priority, a lack of funding, a lack of expertise, etc. [. . .] . . .although LMIC could learn from HIC, they cannot simply copy successful HIC strategies. Local circumstances differ. . . [. . .] LMIC should invest in local capacity building to carry out these tasks and create effective road safety communities that involves all players. . . (Wegman 2017)

Although there are challenges, several interesting cases can be observed in low- and middle-income countries and not only related to the adoption of new road safety plans resting on safe system approaches but also how to work with the SDGs in an integrative way. The city of Bogotá in Colombia is one example of a city working with integrative approaches. Perhaps it is in these types of cases where we can find new approaches and methods in order to take the next step in road safety policymaking.

This chapter has focused on the diffusion of Vision Zero within the area of global road safety concluding that Vision Zero plays a role in the consolidation and development of road safety as a global policy issue. One interesting question that arises is if the establishment and consolidation process of road safety as a global policy area differs from other areas entering the global policy family. Every area is of course unique, containing an intricate web of actors, policy preferences, and problems (c.f. the issue of HIV/AIDS in Harman 2010), but we have also witnessed a more general growth in bilateral, multilateral, and transnational processes of collective policymaking since World War II. A comparison between global road safety policymaking and other policy areas would be an interesting and relevant continuation of this project, and in the area of global health, there is an interesting distinction to be made between the global policy development of communicable and non-communicable diseases. Communicable diseases are often viewed as more acutely urgent, as we have seen in the case of COVID-19, and can therefore enter a global policy phase quicker than noncommunicable diseases that tend to linger longer on a national level or possibly regional level. One significant aspect of global governance today as compared to decades ago is that the international system now includes institutions to deal with both crisis situations and day-to-day management of global problems. In any case, it is fair to say that any future comparisons between global agenda-setting processes would have to include aspects such as urgency, problem framing, financial support for data collection, and the establishment of institutions.

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