SWOV Fact sheet

Sustainable Safety: principles, misconceptions, and relations with other visions

Summary
In the early 1990s the Sustainable Safety vision was launched in the Netherlands. This vision which was implemented during the following years, and was updated in 2005, has proved to be a success. This Fact sheet will explain the basic principles. It will successively go into the goals, man(kind) being the measure, the integrated approach of the traffic elements of man, vehicle, and road, the proactive character, and the five principles which are the vision's basis (functionality, homogeneity, predictability, forgivingness, and state awareness). By emphasizing the infrastructural elaboration of the *Sustainable Safety Start-up Programme*, the main effects until now are in that field. However, Sustainable Safety is much more than just infrastructure; this is one of the misconceptions that this Fact sheet deals with. We will also discuss the costs and benefits of the Sustainable Safety measures and the measures that are effective in making fallible people relatively safe in traffic. Finally, we will compare Sustainable Safety with the Swedish Vision Zero and with Shared Space, which is a Dutch traffic concept in spatial planning.

Background
Road traffic is inherently unsafe. Our traffic system is designed in such a way that it does not (sufficiently) prevent crashes and severe injuries. The most dangerous in traffic are the large differences in speed and mass that surround the human being, who is physically vulnerable and, moreover, makes errors and commits offences. Each year this results in hundreds of road deaths and many thousands severely injured in the Netherlands.

The idea that traffic is inherently unsafe should be a starting point in improving its safety. This relatively recent insight was inspired by developments in other sectors, such as aviation and the process industry. Road safety improvement has been viewed from various perspectives in the past: from the crash as a unique event (early 1900s), crash-prone driver theories (1920-1950), the crash as a risk phenomenon (1940-1960), the multi-causal approach (1960-1980), man as the weak link to be dealt with (1980-1990), until finally the integrated system approach of Sustainable Safety (Koornstra et al., 1992). The Bruntland report about sustainable development was the inspiration for choosing the term 'sustainable'. This report defines a sustainable development as a development that answers to the needs of the present generation without harming the possibilities of future generations to answer to their own needs. It was based on the idea that 'the system' needed to be structurally changed so as to be of benefit for future generations as well.

During the last few decades, the main approach for tackling dangerous locations was a reactive method known as the black spot approach. Sustainable Safety proposed a proactive approach which involves a mainly generic approach to the weaker spots in the traffic system. These weak spots are determined on the basis of their potential danger. This is derived from the possible conflict situations that occur and the conditions under which they occur. The launching of the Sustainable Safe vision found political support, and this resulted in a number of demonstration projects, and finally to the *Sustainable Safety Start-up Programme* in 1997. Striking elements were the strong growth of urban 30 km/hour zones and the implementation of residential 60 km/hour zones in rural areas. This is how Sustainable Safety acquired a strongly infrastructural character, even though measures in other areas, such as education and enforcement, are also an essential component of the vision and developed strongly, separate from the Start-up Programme.

More than a decade after the appearance and implementation of the Sustainable Safety vision, the time had come to evaluate the vision and the direction it had taken. This was to give the vision a new impulse and to anticipate on new policy developments such as the continuing decentralization. The

evaluation resulted in the updated vision entitled *Advancing Sustainable Safety* (Wegman & Aarts, 2006). The updated vision distinguishes itself by:
– continuing the successful past infrastructural measures;
– putting more emphasis on education, regulations, and enforcement;
– emphasizing technological developments;
– arguing the necessity of a quality assurance system;
– arguing the necessity of an integrated approach of measures, safety principles, and policy areas;
– pointing out the importance of thorough assessments, knowledge storage, and knowledge exchange.

What is the crux of the vision?
Sustainable Safety aims to prevent (serious) crashes, and where this is not possible, to almost eliminate the risk of severe injury. *Man as the measure of all things* has been adopted to achieve this goal. After all, the human being is the key figure in traffic and also an important source of unsafety. Man's measure is determined by two characteristics:
1. the human being is physically vulnerable and thus susceptible to injury, and
2. the human being, irrespective of background, education and motivation, does make errors and does not always abide by the rules; that is why man is an important cause of crashes.

Sustainable Safety aims to prevent these errors and offences as much as possible or to soften their consequences by allowing for human limitations when designing the traffic system. First of all the surroundings, such as the *road* and the *vehicle*, should be tuned to man's capabilities and offer assistance and protection. In addition, information and education should prepare the human being for the traffic task, and, finally, his safe or unsafe traffic behaviour must be checked.

What are the principles of Sustainable Safety?
In order to achieve a sustainably safe road traffic, a number of guiding principles have been drawn up (see the Table). The current principles are all based on scientific theories from psychology, biomechanics, and road engineering (see also the Fact sheet *Background of the five Sustainable Safety principles*)

Sustainable Safety Principle	Description
Functionality of roads	Monofunctionality of roads as either through roads, distributor roads, or access roads in a hierarchical road network
Homogeneity of mass and/or speed and direction	Equality in speed, direction, and mass at moderate and high speeds
Forgivingness of the environment and of road users	Injury limitation through a forgiving road environment and anticipation of road user behaviour
Predictability of road course and road user behaviour by a recognizable road design	Road environment and road user behaviour that support road user expectations through consistency and continuity in road design
State awareness by the road user	Ability to assess one's task capability to handle the driving task

What do we know about the effects of the Sustainable Safety principles?
When the *Sustainable Safety Start-up Programme* was introduced, a beginning was made with the large scale implementation of Sustainable Safety measures. The increase and construction of 30 km/h and 60 km/h zones, together with the introduction of the 'Moped on the Carriageway' regulation, were the most important road safety measures in the *Start-up Programme*. Some of the developments, such as the construction of 30 km/h zones, had already begun earlier. The construction of roundabouts, which do fit the Sustainable Safety ideas well, was not part of the *Start-up Programme*. Based on present knowledge, we estimated that the complete package of Sustainable Safety measures that were introduced has resulted in a reduction of about 6% of all deaths and in-patients in the Netherlands during the 1997-2002 period (Wegman et al., 2006).
Traffic education, enforcement, and vehicle technology also are essential parts of Sustainable Safety. At present, there are many developments in these areas. It is of course important to know to what extent these developments affect road safety.
In a recent assessment of *traffic education*, a (small) effect on self-reported behaviour relevant for safe traffic participation was measured in just over half the studied projects (Twisk et al., 2007).
In the late 1990s, regional enforcement teams were set up to approach the *traffic enforcement* in a more efficient and effective way. The new approach was aimed at five areas: helmet wearing, seatbelt

wearing, red light running, drink-driving, and speeding. This resulted in an increase of time spent on the enforcement of each of these issues, accompanied by information campaigns. This was especially effective for seatbelt wearing, speeding, and red light running (SWOV, 2007). The increase in seatbelt wearing during the 1994-2001 period, for example, resulted in about 3% fewer road deaths among car occupants (see also the Fact sheet *Effects of police enforcement of protection devices and moped helmet use and red light running*). The increase in seatbelt wearing was the result of both enforcement efforts in combination with campaigning, as well as of the visual and auditory seatbelt reminders in cars.
For many decades, there have been worldwide developments in *vehicle technology*; that aimed at preventing injury, and increasingly at preventing crashes. A British study reports that the introduction of vehicle measures, excluding compulsory seatbelt wearing, has resulted in an annual reduction of injury crashes by about 1% during the 1983-1998 period (Broughton et al., 2000).

What are the misconceptions about Sustainable Safety?
Misconception 1: man is the cause, education the solution
Man has a central position in traffic. This means that traffic is confronted with human abilities and limitations. These human characteristics are partly individual and partly universal. For example, a universal ability is that people can quickly recognize patterns, and a universal limitation is that people, even if well trained and motivated, make errors. This is confirmed by accident analyses. Beside vehicle and road defects, man is the most important cause of crashes. An often heard opinion is that, hence, education is more important than infrastructure and vehicle measures. This line of thought fails to allow for the line of thought that the design or layout of the road environment can contribute to the prevention of errors, or at least that it can ensure that errors have less serious consequences. Particularly these what could be called 'hard' features of the road environment can influence human behaviour. Education of course plays an important part in this, but has a limited range. Ultimately, it is important to know the effectiveness of various types of measure and to use this knowledge for tuning the measures to each other.

Misconception 2: Sustainable Safety is solely an infrastructural matter
The original Sustainable Safety vision is an integrated approach which combines the elements man, vehicle and road. However, the sustainably safe infrastructure was initially elaborated the most concretely, and was emphasized within the *Sustainable Safety Start-up Programme*. This gave rise to the misconception that Sustainable Safety only refers to infrastructure and that behaviour modification, i.e. education and enforcement, is just an addition to road infrastructure measures. However, education, rules and regulations, enforcement, and vehicle technology are just as much a part of a sustainably safe traffic system. Of course it is also true that by nature infrastructure has a more sustainable character in the sense of material sustainability, requiring relatively little maintenance, whereas measures such as education and enforcement require continuous efforts if they are to have any lasting effect. Furthermore, the expression 'behaviour modification', with the meaning traffic education and enforcement, incorrectly implies that education and enforcement are the only measures that can modify behaviour. However, man's environment, i.e. infrastructure and vehicles, also has an important impact on behaviour (see also misconception 1).

Misconception 3: Sustainable Safety (i.e. infrastructural) measures are expensive
An often-heard complaint is that the infrastructural Sustainable Safety measures in particular are expensive. To what extent the costs can be considered acceptable, can best be judged by looking at the social return on investments. The 'high' costs can be put in perspective by also looking at the benefits: savings on medical costs, on the costs of production-loss, loss of the quality of life, property damage, and settlement costs (see the Fact sheet *Road crash costs*). The returns of various Sustainable Safety measures differ, but the Netherlands Bureau for Economic Policy Analysis judged the measures in their entirety as 'robust' in terms of costs and benefits (CPB et al., 2002). Furthermore, SWOV has introduced the term 'avoidable crashes' (Wegman, 2001), which means that specific crashes can be prevented by taking measures that are effective and socially profitable as well as fitting within Sustainable Safety.

How does Sustainable Safety relate to other visions?
The Swedish road safety vision: Vision Zero
The Swedish Vision Zero (Tingvall, 1997) starts from the idea that is immoral not to do everything possible to prevent road deaths and injuries. In this vision, fighting to improve road safety is more important than solving other traffic problems. Like Sustainable Safety, Vision Zero also maintains that

even if a human being has caused a crash, the underlying cause can nearly always be traced back to the traffic system. This assumes a joint responsibility of the road user and the road authority. The user's responsibility is to obey the rules, and the authority's responsibility is to arrange the system in such a way that human errors are committed as seldom as possible, with as few serious consequences as possible.
Vision Zero thus also sees man as the measure of all things. A clear difference with Sustainable Safety is that Vision Zero only makes statements about the physical environment, i.e. vehicle, road, and other traffic. Enforcement and education are not regarded as system components. Obeying the rules is considered the road user's own responsibility; this as opposed to Sustainable Safety, which considers it to be a human weakness. Educational aspects of man in traffic and his moral and social actions (principles such as social forgivingness and state awareness) are not included in Vision Zero. Furthermore, the Swedish system is less concrete about measures to be taken, whereas within Sustainable Safety the principles and how to put them into practice have been detailed.

Shared Space: a spatial planning vision
Another vision that is interesting to compare with Sustainable Safety is Shared Space (Monderman, 2004). This Dutch vision refers to the creation and design of residential areas – in fact only the access roads, although the idea is sometimes applied in a broader sense. Shared Space is based on the point of view - as the name illustrates - that residential areas are 'shared areas'; shared by people who live there and road traffic. Traffic in these areas is the guest and the layout should clearly indicate that the primary function of the area is residential. Access roads, however, are also meant to facilitate traffic to and from destinations.
In fact, Shared Space is a vision of how residential areas can be made more credible by making use of as many natural and historical elements as possible that match the road's function. As little use as possible is made of road signs and markings to allow people to settle potential conflicts by eye contact. This approach is also expected to result in lower driving speeds. In fact, the traditional traffic engineering development of residential areas often uses conspicuous speed limiters such as speed bumps, against which there is growing opposition. According to Shared Space, such traditional measures strongly reflect a 'traffic area', whereas traffic features should be less prominently present in residential areas. Further study should be made of the extent to which a layout according to the starting points of Shared Space is in line with Sustainable Safety elements such as recognizability and social forgivingness.
Finally, Shared Space emphasizes the importance of a well designed road network. Without well designed through roads, there will only be more rat run traffic on the secondary road network, with all its consequences.

How do we advance with Sustainable Safety?
A number of Sustainable Safety principles have already been translated into practical implementation. This is especially the case for functionality (categorizing the road network), homogeneity (separating motorised and unprotected road users on high speed roads and constructing residential areas), physical forgivingness (safe road shoulders), and predictability (a variety of infrastructural measures). In the coming years, the implementation of these principles will be studied where necessary. This is where the argument for a system of quality assurance, as well as valid data collection, as was proposed in *Advancing Sustainable Safety,* will play an important part.
Quality assurance should ultimately result in the traffic system in the Netherlands at least meeting the yet to be defined minimum safety level. SWOV intends to elaborate this for infrastructure during the coming years.
The elaborations of the two principles of state awareness and social forgivingness are still in their infancy and will be studied further in the coming years.

Sustainable Safety also plays an important role in recommendations for achieving road safety targets in the near and distant future. SWOV continues to argue for a 'system leap' in policy and ideas relating to road safety improvements. To achieve the road safety targets, the regional and municipal governments also fulfil an important role. They increasingly feel the need of support for a good embedding of the updated Sustainable Safety vision in their existing policy plans. More activities are gradually being unfolded to answer to this need.

Safety is not the only matter of importance for traffic and transport policy. Policy also needs to take accessibility, pollution, quality of life, and spatial planning into account. Because all of these wishes have to be achieved with limited budgets, the various interests need to be integrated as much as

possible. Therefore, road safety policy not only needs to aim at further integration of the man-vehicle-road elements and the five Sustainable Safety principles, but also at integration with other policy areas and traffic and transport problems. In this manner, it should be possible to achieve an entirely sustainable mobility. In the coming years, also this issue will be subject to an undiminished search for dialogue and cooperation.

Conclusion

Sustainable Safety as a vision will become ever more important in making traffic safer now that the strong location-bound crash peaks continue to level off. With a proactive and integrated approach of the traffic elements man, vehicle, and road and an integrated application of the Sustainable Safety principles, it should be possible to force road safety firmly in the right direction. In the current complex world, it is more important now than ever before to join in with other developments such as exposure, pollution, quality of life, and spatial planning. Rapid changes may cause an idea that is unrealistic today to be acceptable tomorrow. Ultimately, social support remains an important pillar for converting a system vision of road safety, such as Sustainable Safety, into actual policy and measures.

Publications and sources
(SWOV reports in Dutch have an English summary)

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