The common strategy for safe bicycle and moped traffic 2018
Foreword

The bicycle traffic is an essential part of a sustainable transport system, and cycling makes a vital contribution to an increase in public health. Increased cycling also contributes to reducing the impact on the environment and climate. However, bicycle traffic must be safe for it to be considered long-term sustainable. Today, cyclists make up almost half of the total number of seriously injured in the road traffic in Sweden. With that starting point, the work for Vision Zero becomes (the vision that no one is to be killed or seriously injured in the road traffic) a key challenge in work for increased cycling.

Currently, we see a substantial electric-bicycle development and sales are heading to similar levels, as in many other countries in Europe. Bicycles and class II moped share the same infrastructure at the present day. Therefore, measures for safer cycling usually also have a positive effect on the safety of class II moped riders.

This developed strategy for safe bicycle and moped traffic is the result of the collaboration between different authorities and actors. The purpose of the partnership is to, in a way, systematically try to understand and handle the challenge of increasing safety for both cyclists and moped riders. Several of the issues addressed in the strategy is complex. It is, therefore, essential with further analyses to continuously develop knowledge in the field.

The developed strategy provides a basis for proceeding planning within government authorities, municipalities and other actors. The hope is that the prevailing strategy will serve as a source of knowledge and inspiration for those actors who want to contribute to safe bicycle and moped traffic.

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The Swedish Consumer Agency
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Summary

The strategy is for both bicycle and moped traffic. The bicycle traffic is an essential part of a sustainable transport system, and cycling is a physical activity that makes a vital contribution to an increase in public health. However, bicycle traffic must be safe for it to be considered sustainable in the long-term. Increased cycling will result in an increase in the number of killed and seriously injured cyclists unless we take targeted and effective road safety measures. With that starting point, the work for vision zero becomes (the vision that nobody is to be killed or seriously injured) a key challenge in work for increased cycling.

During the year 2017, 26 cyclists died in road traffic, which is an increase compared to 2016. The most common cause of death has been a collision with motor vehicles in previous years, but in the year 2017, as many cyclists died in single-accidents as in collision with motor vehicles. Cyclists constitute the largest group with severe injuries in road traffic and the year 2017, more than 2000 cyclists received invalidating injuries. About 80 per cent of the serious injuries occurred in single accidents casualties.

The vision zero also applies to the moped traffic. The year 2017 was an exceptional year with only one deceased moped rider, while it is usually the death of about six people a year. In the year 2016, eight moped riders died, and 245 moped riders were seriously injured. Over the last ten years, the number of deaths and seriously injured on the moped has been laid on a lower level compared with previous years. An explanation is that the requirements for driver’s license for Class II moped and requirements for AM-driving license for Class I moped were introduced in the year 2009. Another possible explanation for the decrease in moped accidents is that the number of 15- and 16-year-olds in Sweden decreased by almost 25 per cent between 2003 and 2013.

Aim
The developed strategy aims to systematise and coordinate road safety work to increase the safety of cyclists and moped riders. The strategy should be an aid in operations’ planning for government authorities, municipalities, organisations and other actors within the sector.

Co-operation
The Swedish Transport Administration has the government’s order to lead coordination of road safety work within the road traffic, and this developed strategy is an integral part of that work. The conduct requires that all actors carry out efforts at local, regional, national and international level within their respective areas of responsibility - individually or in collaboration. The actors contribute mainly by focusing on the prioritise areas of action in their operations.

Delimitation
The developed strategy is limited to 2-and 3-wheel bicycles and mopeds on the roadways.
Target
The vision zero is the long-term goal for safe traffic with bicycle and moped. The goal for this developed strategy is to contribute to the vision zero and the current interim targets of halving the number of fatalities and a reduction in the proportion of seriously-injured cyclists and moped riders by 25 per cent from the year 2007 to 2020. If current interim targets apply to the group of cyclists and moped riders respectively, it means that a maximum of 15 cyclists and six moped riders could possibly be killed in the road traffic by 2020 and the number of seriously injured can reach up to a maximum of 1,500 cyclists and 250 moped riders.

The Ministry of Industry has submitted a proposal for a new interim-target for the year 2030. When there has been a decision on the latest target, it will be central to continued work after the year 2020.

Prioritised areas of action
To increase the safety of cyclists and moped riders, it is essential to both prevent crashes and to alleviate the consequences of an accident if it should occur after all. Prioritised action areas for increased safety for cyclists and moped riders are, therefore:

• Safe Infrastructure
• Operation and maintenance with good quality
• Safer bicycles and mopeds
• Safer passenger cars and heavy vehicles
• Increase in use of helmet and other protective equipment
• Behavioural interventions

Ambitions to contribute
The participating organisations have described their initial aspirations to be conducive to increased safety for cyclists and moped riders. The lay-down of the descriptions is in a separate memorandum.

Follow-up and regular development
The road safety work is determined by target management, and this means setting targets for several indicators. The indicators are then followed up and evaluated in an analysis report, presented at an annual national conference. Already included in that work are the safety of cyclists and moped riders, by representing it with a certain number of important indicators that are monitored over time.

Also, the Swedish Transport Administration will respond to a follow-up of the ambitions that different actors report in the separate memorandum. The Swedish Transport Administration will also initiate a review of this developed strategy when deemed appropriate.
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Appendix 1

Assessed measure’s potential
Concepts and definitions in the document:

- **Serious injury**: An injury to a person that leads to the permanent physical impairment of at least one per cent. As classified based on the emergency medical care injury report.

- **Bicycle**: The definition of a bicycle has changed, and there are three other vehicles categorised as bicycles in addition to the “regular” pedal bicycles:
  - Electric vehicle with pedals, with a power of max. 250 watts that can only boost the throttle up to 25 km per hour
  - Electric electric vehicles without tramps, at the maximum speed of 20 km per hour; (a) max 250 watts or (b) self-balancing (e.g. Segway)
  - Electric vehicles without tramps for persons with physical disabilities who have none power limitation but a maximum speed of 20 km per hour (e.g. electric wheelchair and electric scooter).

- **Bicycle Crossings**: A part of a road intended for use by cyclists or moped class II drivers to cross a roadway or a bicycle path and which can be specified by the road lane markings. A bicycle crossing is monitored if the traffic is regulated with traffic signals or by a police officer and otherwise unattended.

- **Bicycle Overpass**: A part of a road which, according to local traffic regulations, is intended for use by a cyclist or moped class II drivers to cross a roadway or bicycle path and indicated by the road marking and road signs. At a bicycle overpass, the traffic environment must be designed to ensure that the driving of motor vehicles are not with speed higher than 30 kilometres per hour.

- **Interim-target for the year 2020**: The target of safety in road transport area is to halve the number of death and to reduce the number of seriously injured by a quarter between the year 2007 and 2020. The interim-target states that priority should be given to the measures aimed at improving road safety of children.

- **Euro NCAP**: European New Car Assessment Program - European Evaluation Program for New Cars safety.

- **GCM-road**: Pedestrian, bicycle and moped road.

- **GCM-crossing**: Generic concepts for different crossings organised to clarify where pedestrian, cyclist and moped class II drivers cross a roadway.

- **ISA**: Intelligent support for speed adjustment (Intelligent Speed Adaptation).

- **Moped class I**: Class I moped is a two, three or a four-wheeled motor vehicle designed for a speed of a maximum of 45 km/h.

- **Moped class II**: Class II moped is a two, three or a four-wheel motor vehicle designed for speed of a maximum of 25 km/h and whose power does not exceed 1 000 watts. From January 1, 2016, a new type of moped class II was allowed. It should have tramps and an auxiliary engine with a maximum power of 1,000 watts. The engine may get to only provide a power supplement of up to 25 km/h. Bicycle helmets are enough to ride on this type of moped.

- **Very serious/Severe injury**: It is an injury to a person that leads to a permanent physical impairment of at least 10 per cent. It is classified based on the emergency medical care injury report.

- **The Vision Zero**: The long-term goal of road safety, that no one is to be killed or seriously injured as a result of road accidents in the road transport system, and that the design, function and use of the road transport systems should be adapted to the requirements that follow from this.

- **Accident Prevention**: Interventions to prevent an accident from occurring.

- **Unprotected road user**: They are part of road users on the road who have limited protection and therefore have higher risks in traffic. Unprotected road users include pedestrians, cyclists, moped riders and motorcyclists.

- **Single-vehicle accident**: Accident involving only one vehicle or a road user in the event of a crash without colliding with another road user.
• **Injury Prevention**: Efforts to prevent injury occurring from an accident (as opposed to accident prevention which are measures aimed at avoiding an accident).

• **STRADA**: Swedish Traffic Accident Data Acquisition. System for registration of accidents and injury in the transport system. The Strada system is based on data from two sources: police and emergency care.

• **Safe Traffic**: Safe traffic is defined by the Swedish Parliament and the government’s decision on the vision zero and the related interim targets. See the vision zero and interim-targets.

• **Traffic Environment**: By traffic environment, this document refers to streets and roads, pedestrian and bicycle paths, footpaths and walkways within squares and parks.

• **Traffic accident**: Accident involving a person or property damage in the road transport area, which occurs when at least one vehicle – stationary or in motion - is included.

• **Transport Policy Objectives**: The overall objectives of the Swedish transport policy is to ensure a socio-economically efficient and long-term sustainable transport supply for citizens and businesses throughout the country. Below the overall objectives are functional objectives and impact objectives:
  
  • The function goal is to create accessibility for people and goods. The transport system will provide essential accessibility for all with good quality and usability and contribute to developmental strength throughout the country. The transport system should also be equated by responding equally to the transport needs of women and men respectively.

  • The impact goal is about safety, environment and health that are essential aspects of a sustainable transport system. The design, function and use of the transport system should be adapted to ensure that there is no death or serious injuries. It will also contribute to the overall generation objective for the environment and to achieve the environmental quality objectives, as well as contribute to an increase in health.

### Table of current vehicle types:

<table>
<thead>
<tr>
<th>Vehicles Type</th>
<th>Engine Capacity</th>
<th>Engine assistance</th>
<th>Drive system</th>
<th>Speed</th>
<th>Type approval</th>
<th>Helmet Requirements</th>
<th>Registration</th>
<th>Insurance</th>
<th>Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>-</td>
<td>-</td>
<td>Tramp or crank device</td>
<td>(1)</td>
<td>No</td>
<td>Children &lt;15 years (2)</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>E-assisted bicycle</td>
<td>Max 250W</td>
<td>≤ 25 km/hr</td>
<td>Tramp or crank device</td>
<td>(1)</td>
<td>No (EU’s Machinery Directive applies)</td>
<td>Children &lt;15 years (2)</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Class II moped</td>
<td>Max 1 kW</td>
<td>≤ 25 km/hr</td>
<td>Tramp or crank device</td>
<td>(1)</td>
<td>Yes (3) Bicycle helmet (2)</td>
<td></td>
<td>No</td>
<td>Yes</td>
<td>Driving Proof for age 15 years</td>
</tr>
<tr>
<td>Class II moped (6)</td>
<td>Max 1 kW</td>
<td>Yes Continuous Operation</td>
<td>Throttle lever</td>
<td>25 km/h</td>
<td>Yes (3) Protective helmet</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Driving Proof for age 15 years</td>
</tr>
<tr>
<td>Class I moped (5)</td>
<td>Max 4 kW</td>
<td>Yes Continuous Operation</td>
<td>(Throttle lever)</td>
<td>45 km/h</td>
<td>Yes (4) Protective helmet</td>
<td>Yes</td>
<td>Yes</td>
<td>AM Driving license</td>
<td></td>
</tr>
</tbody>
</table>

(1) Road speed limitation
(2) Bicycle helmet or other suitable head protection
(3) Exceptional mopeds can also be approved nationally through moped inspection
(4) Exceptional mopeds can also be approved by registration inspection
(5) Must not be performed on a bicycle track
(6) Older Swedish 30 km/h mopeds belong to class II

- An e-assisted bicycle that meets the above requirements is by definition a bicycle.

- Bicycles does not need to be type approved but must be safe accordingly, in compliance with provisions of the Product Safety Act.

- Electric assisted bicycles are subject to the requirements of the EU’s Machinery Directive and must meet the specifications of EN 15194 safety standard.

- Bicycles and class II mopeds shall be operated on a bicycle track if any.

- Bicycles and mopeds are not taxable.

- Mopeds must be traffic insured.
1 Collaboration with breadth and systematics

1.1 The vision zero’s shared responsibility

According to the Swedish Parliament’s decision on vision zero, road safety should be shared responsibility between the system designers and road users. The liability is embraced in such a way that the system designers have ultimate responsibility for the design, function and use of the road transport system, while road users are responsible for following traffic rules and showing consideration, judgment and responsibility in traffic. If prolonged ill health occurs or is likely to happen, or if road users do not take their responsibility, system designers must take further action.

The system designer’s responsibility can be considered particularly crucial for cyclists’ safety since there are only some requirements for ability and knowledge, and no standard qualification or age requirements are necessary to be eligible to move around as cyclists in traffic. All citizens have the right to go around in the society as a cyclist, while only some citizens have the right to locomote in the community by other means, an example of such is, a motorist.

For a moped rider, a driver’s license or an AM-driving license is compulsory as of today and a minimum age of at least 15 years. This obligation makes the moped riders more demanding than cyclists, but yet lower requirements than motorists.

The traffic pyramid deciphered, is as the fact that the system designs are almost entirely responsible for the safety of the system with regards to the safety of the pedestrians, while the sharing of the responsibility is between system designers and road users with regards to the safety of the motorists. Cyclists are in closer conditions to the pedestrian than the moped riders, who have a formal requirement for qualification, but lower eligibility requirements and age than the motorist.
1.2 Interim-target and target management

Swedish road safety work establishment has been on vision zero and the year 2020 interim target. The Swedish Parliament decided the interim-target that is in effect now in the year 2009 and the formulation has been the number of deaths in road traffic will be halved between the year 2007 and 2020. This interim target means that the number of death by the year 2020 should be no more than 220. The decision also means that the number of seriously injured in road traffic shall be reduced by one quarter during the same period.

The Traffic Analysis Authority on behalf of the government's mission has investigated and proposed a new interim target for the number of fatalities and seriously injured in road traffic after the year 2020. The proposal has been submitted, and the preparation is currently underway by the Ministry of Enterprise, Energy and Communications.

To achieve the current interim-target, so-called target management is applied. The core of the goal management is to follow up on traffic safety developments annually based on several indicators that affect how many people are deceased and seriously injured in the traffic. Every indicator has a target level to be reached for the interim target to be achieved. Based on these indicators, the measures and activities can then be connected to steer towards set targets. These are followed up and evaluated annually in an analysis report and presented at a national results' conference. (Nationell resultatkonferens)

From current indicators for the year 2020 interim target, there are several that concern the safety of cyclists and moped riders. The indicators operate and maintain pedestrian and cycling routes in urban areas, safe walking, cycling and moped crossings, and cyclists and mopeds helmet have a direct connection to bicycle and moped traffic. However, the indicators also increase speed compliance, sober traffic and safe passenger cars, indirectly affecting the safety of cyclists and moped riders.
1.3 Purpose of the Strategy

The strategy aims to systematise and, where possible, coordinate safety work and thus increase the safety of both cyclists and moped riders.

These activities will occur mainly through the strategy:

• Describes current knowledge mode
• Describes the objectives
• Points out priority areas of action
• Identifies knowledge shortages and clarifies the need for further research and innovation efforts
• Describes the participating actors’ initial ambitions to contribute to the work (see separate PM)
• Clarify how follow-up is going to happen.

1.4 The common strategy as a basis for activities plans

Vision Zero is the long-term goal for safe traffic with bicycle and moped. This strategy aims to help halve the number of fatalities of cyclists and moped riders and to reduce the number of the seriously injured by 25 per cent between the year 2007 and 2020.

By the application of the interim-target for these road user groups, it means a quantified target of reducing the number of fatalities to a maximum of fifteen cyclists and six moped riders by the year 2020. Also, it means that the reduction in the figure of seriously injured to a maximum of 1,500 cyclists and 250 moped riders by the year 2020.

According to the European Parliament (European Parliament resolution, 2011), the Parliament fully supports the target of halving the number of fatalities in the EU between the year 2010 and 2020. Parliament also calls for more clear and measurable goals for the period of 2010-2020. The European Parliament considers, among other things, that the number of killed pedestrians and cyclists should be reduced by 50 per cent and that the number of people with life-threatening injuries should be reduced by 40 per cent from 2010 through 2020. The European Parlia-
ment has thus stated significantly for more far-reaching target levels for maximum deceased and injured cyclists by the year 2020 than described above for Swedish advent.

In order to be able to reach both the vision zero and the current interim target by the year 2020, it requires a combination of effective measures in both the short and long-term for safe traffic with both bicycle and moped. The strategy should be a tool in proceedings planning for government authorities, municipalities, organisations and other actors within the field. The joint conduct requires that all actors who support the strategy carry out their actions in line with the priority areas of operation at local, regional, national and international level – individually or in collaboration with others. The strategy takes its starting point in previous work and target formulations, with the following particularly important:

- A national bicycle strategy for increased and safe cycling - contributing to a sustainable society with a high quality of life throughout the country in the year 2017
- Road safety development analysis in the year 2017 – Target management of road safety work towards the year 2020 interim target
- National cyclebokslut in the year 2016 – How does cycling develop in Sweden and where is it going?
- Increased safety on motorcycle and moped - Joint Strategy Version 3.0 for the year 2016-2020

1.5 Limitations
The strategy is limited to 2- and 3-wheel bicycles and mopeds on the road. The work, based on an analysis of the road safety of cyclists and moped riders, primarily based on today’s situation. This development means, among other things, new types of bicycle-vehicles do not get dealt with in depth.

1.6 Follow-up and the regular development of the strategy
In addition to the monitoring of indicators development will the Swedish Transport Administration initiate a follow-up of the ambitions that different actors report in a separate memorandum. This initiation, to clarify what activities which are ongoing within the priority areas of action as well what has been the development regarding new knowledge. The Swedish Transport Administration will also initiate a review of this focus when deemed appropriate.
2 Bicycle and moped in the Vision Zero

2.1 Safe bicycle and moped traffic

To achieve both increased and safe cycling, infrastructure, vehicles and personal protective equipment need to collaborate and complement each other. A safe infrastructure for cyclists is essential to improve accessibility while reducing the number of cycling accidents with serious-injury cases as a consequence. Until now, much of the work on a safe infrastructure for cyclists and moped riders have focused on dealing with collisions with motor vehicles, such as, for example, safe crossings, reduced speed limits in urban areas and on national roads as well as various speed-impaired measures. Vehicle development also contributes to reducing the number of serious accidents and injuries, thanks to more crash-friendly car fronts and automatic emergency brake on cars.

However, the measures taken so far have not equally focused on the prevention of single-accidents among moped riders and cyclists. Although, the need for better maintenance has begun to be highlighted in recent years by both the municipalities and the Swedish Transport Administration as road-authorities. However, further steps need to be taken to develop better maintenance of the infrastructure based on both the needs of cyclists and moped riders for safety. Two-wheel bicycles and mopeds are more susceptible to lack of infrastructure maintenance than vehicles with more wheels, which makes crashes easier due to slips, gravel or cavities among others. The development of the bicycle design and safety systems, such as, for example, ABS (lock-free brakes) should have the potential to reduce crashes and should, therefore, be encouraged. Most importantly, in the shorter perspective, however, is that the operation and maintenance of the infrastructure are improved, to minimise the risk of a single-accident.

In other words, the bicycle infrastructure needs to undergo the same development process in place for the car infrastructure, where there is the minimisation of the risk of severe conflicts at the same time as the managing of the collision impact of an accident by effective interaction between mainly vehicles, road environment and protective equipment. This development means that a safe and accessible bicycle infrastructure should have sufficiently high and predictable friction, as well as supporting proper use by being accessible, coherent and dimensioned for high capacity. Where the road-authorities wants a faster or more uninterrupted and safe flow of cyclists and moped riders, they must be in separation from other road users’ groups, in whole or in part.

A significant future challenge is to create a safe interplay between public transport, bicycle traffic, moped traffic and pedestrian traffic while avoiding unnecessary accessibility for these more sustainable modes of transportation. Within those parts of the system, where seeking for it to be accessible has been high for cyclists and moped riders, it is highly essential to have safe side areas and that there is no encounter with cycling and moped traffic.
Vision zero assumes that no human being is perfect. Everyone makes mistakes in road traffic, but these mistakes should never cause anyone to die or suffer from permanent injury. According to vision zero, every serious-injury or death in road traffic is a consequence of the fact that the transport system is not sufficiently well adapted to take care of the human error. A safe and sustainable road transport system, therefore, must be able to handle the deficiencies and limitations of humans, without limiting individuals’ ability to move freely in the environment based on the rules of the game that the society has put up.

With increased cycling traffic, more killed and injured cyclists will follow unless by taken of extraordinary measures. However, even if we were successful in creating a safe design and proper maintenance of the bicycle and moped infrastructure, serious accidents will continue to occur. The vision zero’s safety philosophy is about planning for crashes, and even to accept that injuries to people happen - as long as they do not lead to permanent health problems. Vision zero does not concede to the severe consequences of traffic accidents in the form of deaths and invalidating injuries to road users.

Human tolerance to external violence is the dimension to what measures the speeds, or motion energies, that can be allowed in a safe road transport system. Moreover, to achieve a safe road transport system, the force of the system must be able to be taken care of so that a crash does not cause road users to suffer fatal or serious-injury leading to death.

To increase the force absorption in the event of a crash with cyclists and moped riders, different parts of the traffic environment and vehicles need to be adapted to each other to minimise the strain on the road user, for example, by crash-friendly vehicle fronts, shock absorbing asphalt and resilient posts and curbstones. However, above all, it is also required that the cyclist uses personal protection that can reduce and distribute the knock on different parts of the body, in such a way that death and invalidating injury does not occur.

Today’s helmets are effective in preventing serious-head-injuries through their ability to distribute and reduce the forces that occur in a stroke against the head. One of the conditions for getting a road transport system that is both attractive and safe for cyclists is that cyclists use helmets.
2.2 Safe bicycle traffic as part of Agenda 2030

Agenda 2030 shows that a sustainable transport system is a prerequisite for a sustainable society. Road safety is an integral part of sustainability which by identification is, among other things, in two sub-targets of Agenda 2030 (3.6 and 11.2). In the short term, according to one of the sub-target (3.6), is to halve the number of deaths and injuries in road accidents in the world by the year 2020.

Based on Agenda 2030, the execution of the road safety work should be in a slightly longer term, and it should be linked clearly to different sustainability aspects to create both safe and secure, accessible and attractive environments, not least for pedestrians and cyclists. The road safety work should, therefore, take place with regards to other important goals for social development. At the same time, as has been noted, that a sustainable road transport system must be safe to be able to consider it as long-term sustainable. For road traffic to be sustainable and attractive in long-term, therefore, the vision zero’s safety philosophy must be taken into account in all parts of the work. This view is especially right for pedestrians and cyclists, where there are clear synergies between a safe, accessible and attractive transportation system.

One of the targets of Agenda 2030 is the goal of sustainable cities and communities. Sub-target 11.2 is that “by the year 2030, to provide access to secure, economically affordable, accessible and sustainable transport systems for all. Improve road safety, especially by expanding public transport, paying special attention to the needs of people in vulnerable situations, women, children, people with disabilities and elderly people”.

The objective, therefore, means that part of the Agenda 2030 work is to provide access to secure transport systems for all and to improve road safety with a focus on the needs of specific vulnerable groups, not least children and the elderly. In Swedish road traffic, pedestrians and cyclists are among the most vulnerable groups, as seen on the number of killed and seriously injured.

Since daily movement is of vital importance to public health, the transport system needs to create satisfactory conditions for safe, secure and attractive travel environments, which stimulates daily-active travel. Therefore, it is crucial to handle both increased and safe-mobility for cyclists and pedestrians, and not set these ambitions against each other. To meet the requirements of Agenda 2030, work for improved road safety and increased physical activity among pedestrians and cyclists must be handled as a whole and not weighed against each other.
### Challenges

#### 3.1 Bicycle traffic will increase

Health is one of the transport policy impact objectives, which means that the designing of the transport system should be with due consideration to, among others, public health. Increased physical activity through a transfer from car traffic to bicycle traffic has significant positive effects on public health.

The year 2016 "Cykelbokslutet" shows, among other things, the journey by bicycle. An average day cycling by around 800,000 people, on average about 7 kilometres each. They were travelling an assured average of 2500 km per year. The total distance travelled by bicycle was about 2 billion kilometres per year between the year 2014 to 2016. This travel distance corresponds to about two per cent of the total transport work, excluding flights.

An average bicycle trip extension has been from 2.6 to 3.3 kilometres since the year 2005/06. It is the men between the ages of 25 and 74 who are behind this extension of the bicycle trips. Men make use of the bicycle for about 40 per cent longer than women, a pattern that is recognised by other traffic modes and which are among others linked to distances to work.

The total number of bicycle trips evenly distribution has been over the age groups up to 64 years. The group from 65 years old and upwards account for about one-tenth of all bicycle trips. Large-scale number of bicycle trips takes place in major cities with suburban municipalities, around 40 per cent. Large cities and other municipalities (smaller urban areas, countryside and rural municipalities) account for about 30 per cent each.

Several international studies have shown that increased physical activity is the single most substantial contributing factor to the positive health effects of cycling (Holm et al., 2012; Rojas-Rueda et al., 2013).

In addition to increased physical activity, increased cycling can also contribute to reduced air pollution. A Swedish study has shown that if 111,000 people in Stockholm (who have less than 30 minutes commuting time by bicycle to work) chose the bicycle, 449 years of life would be saved every year as an effect of reduced air pollution. (Johansson et al., 2017). However, another study based on the same scenario shows that in addition to the significant positive effect, adverse consequences in terms of 176 lost years of life occur due to injuries and deaths from traffic accidents (Nilsson et al., 2017). This study result means that a significant part of the health benefits "disappears" due to injuries and deaths. Work on creating a safe system for cyclists is, therefore, an essential part of the work to maximise the health benefits of cycling. In this way, measures aimed at improving the safety of cyclists will also be an investment for increased public health.

Reduced environmental and climate impact are other vital objectives in transport policy. Car traffic noise, emissions of acidification, fertilisation and substances from ozone formation harm nature and human health. To promote increased cycling is essential to counteract these effects.

According to the transport policy’s functional objectives, the travel of citizens’ will be improved by increased reliability, security and comfort. The goal also states that children's ability to safely use the transport system themselves and stay in traffic environments will increase. Also, the conditions for choosing public transport, walking and cycling are to be improved. However, to achieve this, it is essential to create an infrastructure that is attractive and accessible for cycling.

How our cities, neighbourhoods and habitats are designed, affect how we transport ourselves. Efforts on accessible, safe and attractive infrastructure for
cycling is an essential contribution to a more active traveller. Urban planning is also vital to reduce distances through, for example, densification, functional mix and a fine mesh road network.

Technology development is far gone, and there are many different types of bicycles today. There is, for example, multi-wheelers, tandem bicycles and bicycles for many people, cargo, box and transport bicycles, bicycle carriages, electric bicycles, arm-bicycles, recumbent bicycles, weather-protected bicycles (e.g. velomobiles) and bicycles built for different speeds. This development implies that new requirements depend on the design of the infrastructure.

3.2 The Bicycle traffic should be safe

The bicycle traffic must be safe for it to be considered long-term sustainable. With this starting point, work for vision zero (that no one will be killed or seriously injured in road traffic) is a crucial challenge in work for increased cycling. Cyclists account for almost half of the total number of seriously-injured in the road traffic.

The most common type of crash leading to killed cyclists is in a collision with motor vehicles, while single-accidents are the most common among seriously injured cyclists. Compared to a motorist, a cyclist has 29 times higher risk of injury and ten times higher risk of death (Nilsson et al., 2017).

3.3 Increased cycling and the number of injured

It is a big challenge to increase cycling while reducing the number of injured and killed cyclists at the same time in road traffic. For cycling to increase, it requires that people switch from a safer way of travel (like public transport or car) to bicycle. Increased cycling means that more people will be injured unless by taken very effective safety measures at the same time.

The road traffic size is the single factor that affects the number of traffic accidents most. To double the traffic can allow for the total number of accidents increase, with 88 per cent (Elvik with several 2012). This factor also generally applies to bicycle traffic. The more the cycling traffic, the more bicycle crashes. To assess how many more people will be injured if bicycle traffic is increasing, the variation between municipalities can be studied. How does the number of people injured in municipalities with much cycling indicates, compared to municipalities with fewer cycling? From this point of view, the estimation can be that the number of injured person will increase by 70-80 per cent by doubling cycling, which shows in a study of one-fifth of the country’s largest municipalities (Spolander 2016).

If traffic increases occur over a more extended period, accidents will increase, but not as the traffic increases. Instead, this reduces the average risk of fatality and injury (expressed per trip, kilometre or vehicle). It is a phenomenon that generally applies to all road traffic. It was already discovered in the late 1940s and was named Smeed’s Law, after the author.

That the risk of crashes decreases as traffic increases, is explained by making society more adaptable to a greater extent. As the traffic increases at a moderate pace, the infrastructure develops, as well as legislation, traffic monitoring, driver training and driving license system, vehicle development, and operation and maintenance. Road users also adapt to each other more closely. It is therefore, about a broad social adjustment process over a long period. This adapta-
tion process, which link has shown to be to car traffic, also applies to a slow increase in bicycle traffic. There it has been named Safety in Numbers, but that is basically about the same as Smeed’s Law. Several international and national studies have shown that in countries, cities or places with much cycling, the risk of the individual cyclist is lower than where there is fewer cycling.

The same general explanation for risk reduction applies to increased cycling as well as to other traffic in general. However, Safety in Numbers, as the name suggests, has emphasised the adaptation of road users between - in particular, the acclimatisation of motorists’ to the bicycle traffic. It is a factor that plays a role in this context, one of many, but that factor is likely to have a limited impact on the risk reduction, as the risk of single accidents (where motorist behaviour does not matter) shows the same size for increased cycling as in collision accidents.

The risk concept in Smeed’s Law and Safety in Numbers relates the number of injured to the size of the traffic. However, it does not make the transport policy goals. There it’s about absolute numbers. It is the number of killed and seriously injured cyclists that have to reduce, regardless of the size of the traffic.

3.4 Synergy effects and goal conflicts between increased and safe cycling

There are many synergy effects between increased and safe cycling, both in terms of goals and resources. The government’s national strategy for increased and safe cycling noted that Agenda 2030 and the Global Sustainable Development Goals integrate the three equally essential sustainability perspectives among themselves, i.e. social, economic and environmental developments. The global goals of Agenda 2030 include, among others, sustainable transport solutions, road safety and health. These goals should be achieved at the same time and are equally important. It means that work for increased public health through increased cycling and the work to develop and provide a safe system for cyclists can never stand against each other. Instead, been seen among themselves must be as complementary jobs that support each other in pursuit of global goals and a long-term sustainable road transport system.

A system with low safety is not attractive. Cycling means both freedom and a sense of well-being for many people, while cycling can be perceived as a dangerous and unsafe mode of transport. The lack of safety and security for cyclists can, therefore, be an
obstacle to increased cycling. The work to develop and provide a safe system for cyclists is therefore basically working for more attractive cycling.

A system with low safety is also not healthy. Cycling leads to significant gains for public health, but these health benefits can never outweigh or balance against unacceptable health losses in the form of deaths and a serious-bad-injury. The work for a safe system for cyclists is, therefore, a part of the broad and multifaceted work for increased public health. Many of the measures taken for cyclists contribute to both an increased and safe cycling. Measures such as, for example, safe pedestrian-bicycle and moped crossings, safe bicycle paths, better maintenance of bicycle paths, and lower urban speed increase the accessibility of the bicycle traffic, attractiveness and safety at the same time. The measures also improve the safety, contribute to more equitable road traffic, and giving children, the elderly and people with disabilities better conditions for sustainable travelling.

Also, the vehicle development that has taken place in recent years contributes to increased health and safety for cyclists. For example, the development of emergency braking systems and impact-friendly fronts contributes to improved safety at intersections between cars and the unprotected. Automated vehicles make it possible to reduce parking spaces in our future urban environments, which increases the possibility to redistribute current traffic areas for the benefit of cycling and pedestrian traffic.

The bicycle helmets are an essential component of a safe bicycle system. Cycling without helmet poses a high safety risk for the cyclist and can make the journey not to be considered safe. Today, about four out of ten cyclists use bicycle helmets, and the challenge is to get more cyclists to use bicycle helmets. To work for increased voluntary use of bicycle helmets does not conflict with the ambitions to increase cycling. Meanwhile, there is a concern that any form of a helmet law for cyclists would counteract the aspirations of increased cycling. However, given the knowledge we have today, we cannot see a clear scientific connection between the introduction of helmet laws and reduced cycling. Furthermore, the discussion will continue whether there is a conflict between a helmet requirement and increased cycling and the extent to which that conflict is deemed to be.

### 3.5 E-bicycle or moped?

EU Regulation 168/2013 classifies two-, three-wheeled vehicles and quadricycles. Division of Lightweight two-wheel motor vehicles are into two categories; L1e-A (motorised bicycle) and L1e-B (two-wheel moped). Under the national law, the legislation regulates definitions of vehicles through the Act (2001: 559) on road traffic definitions. Each category includes, among others, rules on the vehicle design speed and engine power. The below text does not represent the exact definitions but describes them in general.

In Sweden are the following definitions:

- **E-bicycle 250 watts (25 km/h)** is by definition a bicycle
- **Motorised bicycle 1,000 watts (25 km/h)** is by definition a class II moped
- **So-called “fast E-bicycles” (45 km/h)** are by definition a class I moped.

See page 8 for more information.

A bicycle with an electric motor of 250 watts, a so-called electric bicycle, is not covered by the regulation but is regulated in the Machinery Directive 2006/42/EG. A motorised bicycle may have a continuous rated or net power of no more than 1000 watts, and the engine power switch off must be when the vehicle reaches a speed of 25 km/h. A vehicle of that type resembles an electric bicycle to its appearance but in classification is as class II moped in Sweden. Vehicles similar to electric-bicycles and having a higher rate or net power than a motorised bicycle, fall into the category L1e-B (two-wheel moped) in the EU Regulation. The Regulation application shall be in all Member States in compliance with applicable legislation.

The name in use “motorised bicycle” in the EU regulation, and the name ”fast e-bicycle” is a translation
of the English term speed pedelec (or S-pedelec) that occurs mainly in the Netherlands, Germany and Switzerland. There are also other names for these. In the appearance, there is not much that distinguishes the above three classes of vehicles (electric bicycles, motorised bicycles and fast e-bicycles) and they are also very equally habitual bicycles. Motorised-bicycles and fast-electric bicycles are rare in Sweden, according to available sales statistics. However, there is the possibility of direct importation of some such bicycles, and therefore are not being included in the statistics.

3.6 The number of electric bicycles increases

An electric-bicycle with pedals provides a power boost up to a maximum speed of 25 km/h with a continuous rated power on the motor equivalent to 250 watts. The vehicle is classified in Swedish legislation as a bicycle and thereby follows the same rules that apply as for bicycles.

The electric bicycle in Sweden is heading towards the sales levels which is available in several European countries. As of the year 2012 electric-bicycles represented 20 per cent of the total new bicycle sales in the Netherlands. Now Germany has reported the same share. In Sweden, the proportion of electric bicycles new sales is up to about twelve per cent. The market estimate shows that the 2015/2016 season there about 45,000 electric-bicycles were sold, and 2016/2017 season about 67,500 electric bicycles were sold in Sweden. In total, approximately 550,000 bicycles are sold annually in Sweden.

Since September 20, 2017, the person who has bought an electric assisted bicycle or electric moped had the opportunity to get twenty-five per cent of the purchase price subsidised, when there was the introduction of a premium. It is expected to provide a further increase in the sales of electric bicycles in the year 2018.

Although there is a reasonable basis for the sale of electric bicycles in Sweden, there are shortcomings in the information about the use of electric-bicycles (the so-called exposure data). For example, resume data usually does not report an electric-bicycle as its means of travel. Measurement points for cycling (for example, bicycle barometers) also cannot distinguish electric bicycles from regular bicycles. Thus, there is no information available about who uses electric-bicycles, and how, when and why they do it. Crashes with electric-bicycles are neither reported nor in an easily accessible way in the STRADA accident reporting system.

However, experience from other countries shows that electric bicycles are:

- Used for all types of travel but mainly commuting and leisure trips
- Replaces primarily car trips and other bicycle trips, but also public transport trips
- Bicycles on average longer stretches than usual bicycles
- Enables cycling for new groups (for example motorists, elderly, cyclists cycling in rugged terrain etc.)
- Cyclings are usually out of town centres and more rural areas than usual for what applies to regular bicycles.

This image is also confirmed by the research which had been done in Sweden (Hiselius et al., 2014).
Compared with strong electric bicycles nations such as, for example, the Netherlands and Switzerland, the proportion and the number of electric bicycles in Sweden are still small. However, development is taking place quickly, and in Sweden, it is also estimated that there is substantial potential for the number of electric bicycles to continue to increase. This development has consequences for the planning of cycling infrastructure and the safety of cyclists.

3.7 Electric bicycles and safety

It is unclear how the accident scene looks like for electric-bicycles in Sweden today. Data on crashes with electric-bicycles have not been collected systematically in STRADA, and are not included in travel surveys. There are also no data about what kind of people / which groups uses electric bicycles today. In the Netherlands, data on electric-bicycles are available. Research shows that there is a slightly higher risk of accident on electric cycling compared with regular cycling per trip (Schepers et al., 2014), but the accident risk per kilometre does not differ from regular bicycles (Schepers et al., 2018).

However, the studies in the Netherlands do not distinguish electric bicycles from other electrically assisted bicycles (motorised bicycles and fast-electric bicycles). There are few studies about safety risks of fast-electric-bicycles (with tramp assistance up to 45 km/h) compared to regular bicycles, but several studies indicate that higher speeds and acceleration on fast-electric-bicycles probably leads to higher severity of accidents (Schleinitz, K. et al., 2015).

If nothing is done, the total number of crashes and the number of accidents with severe consequences may increase slightly as a result of the increased use of electric-bicycles in Sweden. Some possible reasons for this are:

- Increased exposure (more cycling km)
- Higher average speeds
- More elderly and unaccustomed cyclists
- Incorrect expectations among other road user groups (elcyclists look like regular cyclists but their speed can be higher)
- Transfers from car to electric bicycle
- More crashes during an invasion phase.

For the elderly electric cyclists (50 years and upwards – especially 75 years or older), the risk of crashes is higher than that of the average cyclist, and the consequences of accidents are usually more severe.

When looking at different types of crashes, it is reasonable to assume that collisions between electric cyclists and cyclists and corresponding pedestrians become more common and cause more serious-injury than usual cycling, as the electric bicycle is more massive and contributes to an increased speed distribution within the pedestrian and cycling road network.
3.8 Moped riders - a group that not everyone thinks about

Currently we see a powerful electric bicycle development that makes the boundary between cyclists and moped riders becomes less clear. For example, cargo bicycles of various kinds may require the support of a larger engine than 250 watts and do not meet the requirements for a bicycle. Cyclists share infrastructure fully with class II mopeds (which can move at speeds up to 25km/h) at the present day. Therefore, measures for safe cycling usually also have a positive effect on the safety of the class II mopeds. However, there is a requirement for a conscious decision if a class I moped’s (45km/h) is best to be driven in different traffic environments because they cannot be operated on pedestrian, cycling and moped paths.

At the present day, it’s not solely 15-year-olds that are driving a moped. Several groups have discovered that riding the mopeds are an easy way to get out of the big city’s city centres and that it is easy to park. In the sparsely populated area, the moped is still a popular vehicle for mainly young people, as it meets the requirement for them to be able to move around on their own.

During the summer of the year 2017, there were 273,000 registered class I mopeds, according to the traffic register. Of these 108,000 were in traffic, which is as many as the number of traffic during the summer of the year 2007. The number of class II mopeds in road traffic cannot be obtained via the traffic register, as they are not registered but should only be insured. According to the insurance industry, the number of class II mopeds in traffic has decreased. According to Swedish insurance, there were about 44,000 class II mopeds in the year 2016 in road traffic, calculated on annual risk. This figure means that more mopeds can be in service during parts of a year. During the year 2007, there were 81,000 class II mopeds in traffic.

3.9 More 15 and 16 year-olds in coming years

The number of 15- and 16-year-olds in Sweden varies over the years. Between the year 2003 and 2013, the proportion decreased by almost 25 per cent, from about 260,000 to about 200,000. After a levelling-off in a couple of years, the number of 15- and 16-year-olds are now increasing again. By the year 2025, there will be approximately 267,000 15- and 16-year-olds in Sweden. The figure will then expand to about 270,000 until the year 2030, according to SCB. The number of 15-16-year-olds in society can affect the proportion of mopeds in road traffic. However, today we do not know how the distribution of interest will be in this group between, for example, electric-bicycle and moped, but it is an appealing development to follow.
4 Deficiencies and road safety indicators

4.1 Summary of the short description

Fatalities and seriously injured outcomes:

• The number of people killed by bicycle does not decrease at the desired rate. Deaths occur both in the event of a collision with motor vehicles and in single-accident by bicycles.
• The number of seriously-injured cyclists represents the largest group of seriously-injured in traffic accidents and does not decrease. In doing nothing, the number increases in conjunction with increased cycling.
• The number of people killed and seriously injured on the moped has decreased. Measures need to be taken to ensure that further reductions occur, also at an increased interest for vehicles classified as a moped.

Lack of bicycle, moped and traffic safety indicators:

• The proportion of pedestrian, bicycle and moped paths of or with good quality maintenance needs to increase (see indicator 4.5.1).
• The proportion of safe pedestrian, bicycle and moped crossings needs to increase, both within municipal and national road networks (see indicator 4.5.2).
• The proportion of cyclists with a helmet needs to increase, especially among adult shuttle cyclists (see indicator 4.5.3).
• The proportion of moped riders with proper helmet use need to increase (see indicator 4.5.4).
• Speed limits need to be adopted, enforced and be better respected (see indicator 4.5.5).
• The passenger cars need to be safer (see indicator 4.5.6).
• The infrastructure needs to be adapted based on the requirements for safe cycling.
• Trimming and other technical defects on the mopeds need to decrease.
• “Wrong use” and trim of electric bicycle/moped need to be prevented.

4.2 Cyclists are usually killed in a collision with a motor vehicle

By the year 2017, 26 cyclists died which is slightly more, compared to the year 2016 when 22 cyclists died. On average 24 cyclists per year died from 2007 through 2017. Of these, sixty-four per cent died on the municipal road network, and thirty-two per cent died on the national road network.

The most common type of crash in which the cyclist dies is a collision with motor-vehicles, just over three out of four, and over one in four bicycle crashes with fatal outcomes are single accidents.

From collisions with motor vehicles, the most common is the collisions between cyclist and passenger car, two out of three, then between cyclist and truck or bus. Among collisions between cyclist and truck or bus, two out of five fatal crashes happen by the event of right-turning vehicles.

Head injuries are the most common injury to people that causes death among cyclists. In the total number of killed cyclists, fifteen per cent of the cyclists was affected by alcohol or other drugs.

In the year 2017, Folksam has specifically studied the killed cyclists and pedestrians on the national road network. The study comprises 76 killed cyclists (2006-2015). The most common crash situation for cyclists who died on national roads was that they were cycling along the way. Most of the cyclists were hit by a passenger car and on roads with a marked speed
Majority of the cyclists died in daylight (71 per cent). Autopsy reports and other evidence showed that forty-three per cent of cyclists would have survived if they had had a bicycle helmet on. A large proportion of fatal crashes with cyclists could have been avoided with vehicle systems that detect cyclists, such as “auto brakes and auto control.” The infrastructure measures which was considered to be most-effective for the safety of the unprotected road users were separate pedestrian and bicycle lanes, as well as speed-guaranteed pedestrian, bicycle and moped crossings.

4.3 Cyclists are most often seriously injured in single casualties

Every year approximately 2,000 cyclists are seriously injured in road traffic. By the year 2017, sixty per cent of them were seriously injured on the damaged municipal road network, less than ten per cent on the national road network and ten per cent on the private road network. For about twenty per cent, the data is missing on road authorities. In nearly half of the cases, the injuries to the cyclist have been on the way and the bicycle path in densely populated areas, which indicates that it belongs to the municipal road network.

Nearly eighty per cent of serious injuries occur in single accidents, just over ten per cent in conflict with motor vehicles and barely ten per cent with other bicycles. Road-related factors such as shortcomings in operation, maintenance and road design are the contributing cause in 60 per cent of single accidents. Nearly seventy per cent of the crashes were related to operation and maintenance, due to slipperiness because of ice, snow, gravel or leaves. The three bars in the figure above illustrates this.

About fifty per cent of the common serious injuries is an injury to the arms and shoulders, twenty per cent on the legs and hips, and ten per cent on the head. In the case of severe injuries, the proportion of head injury is approximately forty per cent.

4.4 Killed and injured moped riders

Every year, approximately six moped riders died in road traffic. During the period between 2013 and 2017, thirty per cent of them died on the municipal road network and fifty-five per cent on the national road network. Every year nearly 250 moped riders are seriously injured in traffic. During the year 2017, fifty per cent of them were seriously injured on the municipal road network and twenty per cent on the national road network. About fifteen per cent of serious injuries are on the private road network. For nearly fifteen per cent, the data is missing on road authorities.

By studying the distribution of the moped riders’ injuries by the degree of permanent physical impairment and by body part, it turns out that just as for the cyclists, the predominant injuries represent a significantly higher proportion for those who were injured severely than for those who were seriously injured. Nearly forty per cent of all moped riders which has been severely injured has suffered a head injury while the corresponding ratio is only barely ten per cent among the seriously injured.
Following the introduction of AM-driving licenses for Class I and driver’s license for class II in the autumn year 2009, the number of police-reported seriously injured 15-year-olds has declined sharply. There are almost exclusively men who died on a moped. In more than thirty per cent of the total number of killed moped riders, the moped driver was affected by alcohol or other drugs. Among the deads in the age group 18-64 years, the proportion affected by alcohol or drugs is higher than the unaffected. Among those who were younger than 18 years, the number of affected was quite small.

### 4.5 Traffic Safety Indicators

The determining of systematic road safety work target is with the help of several indicators. This method means that targets have been set for several different areas, such that’s called indicators. The target fulfilment for the indicators is followed up and evaluated each year, and then presented during annual results’ conferences. The purpose of the work method is to create long-term and systematic approaches to road safety work. The development of working method has been within the Group of Collaboration in the Vision Zero (GNS way). At present, included in the group are the following organizations: Swedish Work Environment Authority (Arbetsmiljöverket), Folksam, The National Society for Road Safety (NTI), Swedish Police Authority, SAFER, Swedish Association of Local Authorities and Regions (SKL), The

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Starting point</th>
<th>2017</th>
<th>Target in 2020</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of fatalities on the roads</td>
<td>440</td>
<td>253</td>
<td>220</td>
<td>In line with the required trend</td>
</tr>
<tr>
<td>Number of seriously injured on the roads</td>
<td>5,400</td>
<td>4,400</td>
<td>4,100</td>
<td>In line with the required trend</td>
</tr>
<tr>
<td>Share of traffic volume within speed limits, national road network</td>
<td>43 %</td>
<td>45 %</td>
<td>80 %</td>
<td>Not in line with the required trend</td>
</tr>
<tr>
<td>Share of traffic volume within speed limits, municipal road network (Starts in 2012)</td>
<td>64 %</td>
<td>67 %</td>
<td>80 %</td>
<td>Not in line with the required trend</td>
</tr>
<tr>
<td>Share of traffic volume with sober drivers</td>
<td>99,71 %</td>
<td>99,74 %</td>
<td>99,90 %</td>
<td>Not in line with the required trend</td>
</tr>
<tr>
<td>Seat belt use in the front seat of passenger cars</td>
<td>96 %</td>
<td>98 %</td>
<td>99 %</td>
<td>In line with the required trend</td>
</tr>
<tr>
<td>Share of cyclists wearing a helmet</td>
<td>27 %</td>
<td>44 %</td>
<td>70 %</td>
<td>In line with the required trend</td>
</tr>
<tr>
<td>Share of moped riders using a helmet properly</td>
<td>96 %</td>
<td>98 %</td>
<td>99 %</td>
<td>In line with the required trend</td>
</tr>
<tr>
<td>Share of traffic volume for passenger cars with highest Euro NCAP rating</td>
<td>20 %</td>
<td>72 %</td>
<td>80 %</td>
<td>In line with the required trend</td>
</tr>
<tr>
<td>Proper usage of motorcycle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Not yet measured, no target defined</td>
</tr>
<tr>
<td>Share of traffic volume on roads with speed limit above 80 km/h and median barriers, national road network</td>
<td>50 %</td>
<td>76 %</td>
<td>90 %</td>
<td>Not in line with the required trend</td>
</tr>
<tr>
<td>Share of safe pedestrian, bicycle and moped crossings</td>
<td>19 %</td>
<td>27 %</td>
<td>35 %</td>
<td>In line with the required trend</td>
</tr>
<tr>
<td>Share of municipalities with proper maintenance of bicycle paths</td>
<td>18 %</td>
<td>36 %</td>
<td>70 %</td>
<td>Not in line with the required trend</td>
</tr>
<tr>
<td>Systematic traffic safety work in line with ISO 39001</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Not yet measured, no target defined</td>
</tr>
</tbody>
</table>

The table shows the current situation for the indicators and an assessment of whether they have changed sufficiently to reach the year 2020 target.
Swedish National Association of Driver Trainers (STR), The Swedish Association of Road Transport Companies (Sveriges Åkeriföretag), Toyota Sweden AB, The Swedish Transport Agency (Transportstyrelsen) and The Swedish Transport Administration (Trafikverket).

Monitoring of indicators is central to the target management. Each of the indicators has a target value to reach by the year 2020. Together, these target values are reviewed to correspond to the overall target of road safety development. The basic idea is that the year 2020 target will be achieved, thanks to work on systematic road safety - regardless of the impact of external factors (example such as traffic increases) and that of which possible random variations have on the outcome.

Analysis of Road Safety Development in the year 2017 - Target management of road safety work towards the intermediate targets in the year 2020, TRV Publication Number: 2018: 143. The report is developed by an analysis group that consists of analysts from the Swedish Transport Agency, VTI (Swedish National Road and Transport Research Institute) and the Swedish Transport Administration (Trafikverket). From current indicators for the year 2020 interim-target, there are several relating to the safety of cyclists and moped riders as described below.

4.5.1 Maintenance of pedestrian and cycling roads in urban areas

The target level of this indicator, the proportion of municipalities with good quality of maintenance of priority bicycle paths, is seventy per cent for the year 2020. A more detailed definition of the indicator is the proportion of municipalities with at least 40,000 inhabitants who perform high-quality operation and maintenance with good quality for cycling routes that are given top priority within the municipality’s capital. For the good quality, it refers to the condition in terms of standard requirements for winter road maintenance, bare-ground maintenance, gravel and floor opening as well as quality assurance of the standard requirements imposed.

The indicator is measured by a survey every other year, which so far, has taken place in the years’ 2014 for season 2013/14, 2016 for season 2015/16 and 2018 for season 2017/18. The survey has been carried out on behalf of the Swedish Transport Administration and in consultation with the Swedish Association of Local Authorities and Regions (SKL). In the year 2014, there were 60 municipalities with at least 40,000 inhabitants, 59 of whom responded to the survey. In the year 2016, there were 63 municipalities with at least 40,000 inhabitants, of which 54 answered. In the year 2018, there were 64 municipalities with at least 40,000 inhabitants, of which 55 responded. The survey used in the year 2016 and 2018 is a further development and simplification of the survey used in the year 2014.

Based on the answers given by the municipalities in the survey concerning standard requirements and quality assurance of the set standard requirements, municipalities are awarded different points. These points then form the basis for a concerted assessment of the quality level for the respective municipality. The quality level is not an absolute level but is more to be regarded as a relative scale for a comparison between municipalities with at least 40,000 inhabitants. However, the requirements are set so high that the municipalities which are considered to have good quality, have a vast and high level of most requirements that are important for the safety of cyclists.
The proportion of municipalities with good quality of maintenance of priority cycling routes in 2017/18 is estimated to be thirty-six per cent, see figure. The analysis group forecasts that the outcome is not in line with the required development by the year 2020. The result shows the following for the 47 municipalities that responded to both questionnaires in the year 2016 and 2018:

- Thirty-six per cent (17 in number) of municipalities with 40,000 or more residents require the operating and maintenance of priority bicycle paths that are expected to correspond to good quality. This ratio is an increase of two percentage points compared with the 2015/16 season.

- Additional forty per cent (19 in number) of municipalities with more than 40,000 inhabitants was estimated to have medium (yellow) quality for operation and maintenance of priority bicycle paths. This ratio is an increase with just over twelve per cent compared with the 2015/16 season.

- A quarter, barely twenty-four per cent (11 in number) is expected to end up at the level that is too low (red) quality. It is higher by fourteen percentage points compared with the 2015/16 season.

The year 2018 survey shows that fifty per cent of the municipalities had a maximum of 3 cm as the starting criterion for snow removal at ongoing snowfall. Seventy-six per cent of the municipalities has as a requirement that completion of snow removal is at the latest by 7 a.m. Twenty-four municipalities (44 per cent) use swallowing-salt as a method of snow removal and anti-slip control (de-icing) on the priority bicycle road network.

Of the municipalities that are de-icing in the traditional manner, it is only six in number (19 per cent) that performs some sort of course-sweeping during the winter and spring, before the gravel is taken up in the spring.

At an aggregated level, the results from the year 2018 survey show that improvements among the 47 municipalities primarily concerns requirements that affect quality and maintenance of ground without snow, while the standard requirements relating to winter road maintenance and gravel removal do not seem to have evolved considerably.
4.5.2 Proportion of safe pedestrian, bicycle and moped crossings

According to the Swedish Transport Administration's in-depth studies, between 10 and 20 people are killed each year on pedestrian, bicycle and moped crossings in urban areas.

Most of the crashes occur on the municipal road network, where their crossings are not speed-secured. On the national roads, a total of about ten unprotected people are killed annually, when they cross the road. Of these, an average of two people is killed in some form of orderly crossing, which in most cases is not speed-guaranteed. Others have occurred where pedestrian, bicycle and moped crossing is missing entirely, of which about half are in places of urban district similar in character to the environment.

The target for the proportion of safe pedestrian, bicycle and moped crossings indicator, is that at least thirty-five per cent of all crossings on the capital network for cars, should be speed-secured by the year 2020. The target level of thirty-five per cent may seem to be low but poses a significant challenge by the year 2020. It will require changes in the physical road environment design, which means that plans must be established, and resources must be set aside, to raise the quality of safety on a crossing from red or yellow to the green category/quality.

A pedestrian, bicycle and moped crossing is defined as safe if it is flat or if eighty-five per cent of motorists passes in maximum 30 km/h. The latter is accomplished most effectively by having some form of the concrete ramp in connection to the crosswalk point. In this indicator, the capital network refers to streets and roads within functional road class 0-5. For a more accurate definition of safe, moderately safe and unsafe pedestrian, bicycle and moped crossing, see PM Criteria for safe pedestrian, bicycle and moped crossing (Swedish Transport Administration, 2013).

Inventories have been made in the field by compiling what types of pedestrian, bicycle and moped crossings and ramps that exists, as well as where they exist. Crossings are then classified using tools in the map application GIS, based on the set criteria. Data registration are from about 150 municipalities. Some municipalities have also chosen to invent crossings on national roads in the local area. During the year 2016 and 2017, a more systematic inventory was conducted on the national road network: European roads, national roads and regional/county roads (in-comprehensive regional/county roads).

At year-end 2017/2018, the percentage of pedestrian, bicycle and moped crossings with a good standard is calculated to be twenty-seven per cent. The comparison between different years should be interpreted with great caution, as the number of municipalities that invented their crossings has significantly increased. Also, many crossings on national road sections have been added during year 2016 and 2017. The proportion of pedestrian, bicycle and moped crossings with good a standard is on a level by the
The proportion of crossings with medium quality was twenty-one per cent, and fifty-two per cent were of low quality by the year 2017. On municipal road network, twenty-one per cent was of good quality, and the corresponding for national roads was thirty-nine per cent.

The target of bicycle helmets use is that at least seventy per cent of cyclists will be using the helmet by the year 2020. As a measure for the use of bicycle helmet, the proportion of observed cyclists using bicycle helmets is used according to The Swedish Transport Agency’s annual measurements (Swedish Transport Administration, 2018). The measurements do not intend to estimate the total bicycle helmet usage in Sweden in a conventional manner, but it is good enough to give a picture of the change over time and of the estimated level. The measurements have been implemented since the year 2016 with the same methodology as before but with new contractors, which may have influenced the measurement results and make the change between the year 2015 and 2016 challenging to interpret.

The proportion of cyclists with helmet

4.5.3 The proportion of cyclists with helmet

The share of observed cyclists using a helmet and the required development until the year 2020. Source: VTI (through 2015) and new observational measurements in the year 2016, 2017. *Uncertainties due to change of contractors may have occurred in the year 2016.

The figure shows the development of the observed bicycle helmet usage between the year 1996 and 2017. By the year 2017, the observed bicycle helmet usage was 44.2 per cent, which is an increase of almost nine percentage points since the year 2016 when the level was 35.6 per cent. The figure also shows how the use of bicycle helmets needed to change between the year 2007 and 2020 to reach the target level of seventy per cent set to be achieved. This condition means an annual increase of 7.6 per cent. The proportion of cyclists using helmets has, on average, followed the rate of expansion between the year 2010 and 2013, but stopped by 2014. A decrease was noted in the year 2016, then 2017 increased in usage again. Moreover, since the actual level of bicycle helmet usage is twelve percentage points below the curve for the required development, the use of bicycle helmets is considered to have not increased enough since the year 2007 to reach the year 2020 target level.

4.5.4 Proportion of moped riders with proper use of the helmet

The share of observed moped riders using a helmet and the required development until the year 2020. Source: VTI (through 2015) and new observational measurements in the year 2016 and 2017. *Uncertainties due to change of contractors may have occurred in the year 2016.

The share of observed moped riders using a helmet in the year 2012-2017, and the required development until the year 2020. Source: VTI (through 2015) and new observational measurements in the year 2016 and 2017. *Uncertainties due to change of contractors may have occurred in the year 2016.

The figure shows the observed usage of moped helmets in the year 2017. Only moped riders that are perceived to have the helmet firmly fastened are considered helmet user. The result shows that the observed moped helmet usage was 97.8 per cent in the year 2017, compared to 94.8 per cent in 2016, which is an increase of three percentage points. The analysis group assessment is that the development is at the pace in line with achieving the target level in the year 2020 - but as noted earlier, it is a new contractor of the measurements in the year 2016, which makes the results between the year 2015 and 2016 challenging to interpret.
Custom speed limits and better speed compliance

The target is that at least eighty per cent of the traffic work should be within the current speed limit by the year 2020. The target for average travel speed corresponds to a decrease of 5 km/h. Reduced speeds are considered to be one of the indicators that have the most significant potential to reduce the number of deaths.

National road network


The figure shows the observed proportion of traffic work within the speed limit on the national road network. The proportion of traffic work within the allowed speed in the year 2017 is estimated to be forty-five per cent for national roads, which is an improvement of compliance by one per cent unit compared with the year 2016 level when the last national representative measurement was conducted. The outcome in the year 2017 is just over twenty-eight per cent units below the required development to reach the target by the year 2020. On the roads with 70-90 speed limits that are not mid-separated, and therefore, are more speed-critical, compliance has improved slightly from 46.6 per cent in (2016) to 47.3 per cent in the year 2017.

Speed levels and compliance with the current speed limits have not improved but have instead deteriorated since the year 2012.

Achieving the set target levels for the relatively short period remaining until the year 2020 must be seen as very difficult, even though about 200 speed cameras (ATK) are set up annually for automatic road safety control. On these road sections, the cameras provide good effects, but they represent too little of the entire traffic work to influence the outcome of the indicator to a greater extent. Currently there are about 1,600 speed cameras (ATK), and the target is approximately 2,000 pieces by the year 2020.

Reduced speed limits contribute to higher safety through lower speed levels, but at the same time, it will make it challenging to reach the target of compliance because lower speed limits tend to lead to more inadequate or worse compliance.

Starting in the year 2016/2017, the Swedish Transport Administration initiated a critical speed review, with the main focus on the year 2019, to adjust the speed limits to road safety standards. Above all, it is about reducing the speed from 90 to 80 km/h. For the period up until the year 2020, it means that approximately 2,200 km of roads with speed limit of 90 km/h will be lowered to 80 km/h, while more than 400 km of roads with speed limit of 90 km/h are mid-separated and get 100 km/h. During the year 2016 and 2017, 280 and 170 kilometres of roads respectively have got reduced speed to 80 km/h. However, some planned routes to get reduced speed limit have been appealed and take up to the government cabinet level. From a road safety perspective, it is essential to follow the development of such.
Municipal road network


The figure shows the proportion for the observed level of traffic work within the speed limit of the municipality road network during the year 2017. The result shows that sixty-seven per cent of the traffic work is within the current speed limit, which is the same level as the year 2016. The outcome is approximately seven percentage points below the required development to reach the target by the year 2020. The analysis group’s assessment is, therefore, that the development is not in line with the required trend. On the roads with a speed limit of 40 km/h, fifty-three per cent of the traffic drove was within the current speed in the year 2016. On the roads with 50 km/h, there was sixty-six per cent that kept the speed limits, and on the roads with 60 km/h and 70 km/h were eighty-one per cent.

In November 2017, Traffic Analysis submitted a government project aimed at investigating the conditions and consequences of reduced base speed in urban areas, from current 50 km/h to 40 km/h, see Traffic Analysis (2017). Traffic analysis proposes in its report an introduction of a new base speed of 40 km/h within urban/densely populated areas.

To achieve the eighty per cent speed compliance target by the year 2020, it is above all the speed compliance on streets with lower speed limitation (and especially roads with 40 km/h) that need improvement. The compliance can be increased by the design of more urban streets, with the help of, for example by narrowing, bump and change of road width, and so on, so that they become more “self-explanatory” and that it becomes more natural for road users to follow signposts of the speed limit.

4.5.6 Safe Passenger Cars

The share of traffic volume with the highest Euro NCAP safety rating in the year 2002-2017, and the required development until 2020. Source: BIL Sweden, Traffic Analysis (Trafikanalys), Swedish Transport Administration (Trafikverket).

Cars’ safety systems affect unprotected road users to a high degree because they collide with cyclists and moped riders. The ability of passenger cars to pre-
vent the crash and mitigate the consequences of an accident are many times crucial for the outcome. The target for safe passenger cars is that at least eighty per cent of the traffic work, i.e. the number of miles travelled on Swedish roads, is to be performed by passenger cars with the highest safety class according to Euro NCAP (2007). This class means five stars, such as Euro NCAP’s rating system has appeared in the year 2007 and represents the same level of crash safety for those driving in a car like five stars in today’s rating system. In the longer term, this indicator should be further developed to take into account other safety systems relevant to unprotected road users, such as automatic emergency brakes for cyclists and pedestrian.

Euro NCAP has been testing and rating the car’s crash safety since the year 1997. The first cars with the highest safety rating, five stars were tested and launched onto the market in the year 2001. Since the year 2014, the proportion of new cars sold in Sweden with the highest safety rating has been by approximately ninety per cent. This development has resulted in an increase in traffic work with safe cars by around five percentage points per year. Between the year 2016 and 2017, traffic work increased five percentage points, from sixty-seven per cent to seventy-two per cent, see figure. The developments thus go along with the required trend towards the target of eighty per cent in the year 2020.
5 Prioritised Areas of Action

The choice of priorities is based mainly on the safer cycling analysis work – a common strategy for the year 2014-2020, version 1.0 and increased motorcycle and moped safety - common strategy 3.0 for the years 2016-2020. The potential of the measures has been checked towards the outcome for the year 2015 and 2016, see appendix 1.

Based on the challenges, objectives and the facts and analyses previously reported in this regard, the following six priority areas of action have been identified for the joint work on a safe bicycle and moped traffic:

- safe infrastructure 5.1
- operation and maintenance with good quality 5.2
- safe bicycles and mopeds 5.3
- safe passenger cars and heavy vehicles 5.4
- increased usage of helmet and other protective equipment 5.5
- behavioural intervention efforts. 5.6

The focus also points to knowledge gaps that should be addressed to provide a basis for effective solutions in the future.

Within the priority areas of action, the participating organisations have described their initial ambitions to contribute to increased safety for cyclists and moped riders, see separate memorandum.

5.1 Safe Infrastructure

5.1.1 Important stakes
Increased and safe cycling requires an attractive bicycle infrastructure. Therefore, cyclists need accessibility and safety needs to be prioritised in all areas of physical planning. It is essential that both the city’s traffic planning and building’s development planning lead to the attractiveness and safety of the bicycle traffic in a manner that contributes to increased active travel. The traffic planning should lead to the systematic elimination of various safety risks in the traffic environment for cyclists. It is about combating
fatalities and serious injuries in both single-casualties and conflict accidents in the traffic environment. It is also vital that the exploitation of new areas, densification of existing districts and the transformation of different urban spaces is made with the ambition of creating safe, secure, shortcut and fast connections for the bicycle traffic.

In similarity to the bicycle traffic on the road, traffic planning needs to create the conditions for safe moped traffic through various measures in the traffic environment. Many actions taken for safe cycling also increase the safety of those who choose to ride a moped.

The bicycle network in the National Road Database (NVDB, February 2017) comprises a total of 20,930 km distributed across three road authorities:

- municipal road authority 17,330 km
- national road authority 2,560 km
- private road authority 1,040 km.

However, NVDB has shortcomings and is being updated.

**Continued speed review**

The speed, or rather the movement energy, has a significant impact on the safety of cyclists and moped riders. An essential prerequisite for achieving a safe speed is that the signposted speed is adapted to the road or street traffic safety standards. At crossings and on routes where cyclists and moped riders travel, it is vital to have low-speed limits. However, it's rarely enough adjusting the speed limits, without also requiring other measures to ensure a safe speed.

Traffic analysis has investigated the issue of reduced base speed in urban areas (Report 2017:16). Traffic analysis recommends the introduction of a new base speed of 40 km/h within the densely populated area. This new base speed, according to Traffic Analysis, gives positive effects on road safety and security, which in combination with the changing urban environment, in the long run, can lead to more cycling and walking. The issue of reduced base speed is currently being prepared within the Ministry of Enterprise, Energy and Communications.

Within the national road network, the speed limits adaptation is ongoing to increase road safety traffic for the car traffic. Reductions from 90 to 80 km/h, among others, have a positive impact also on the safety of unprotected road users, although it does not provide a sufficiently high level of protection for cyclists and moped riders. It is therefore desirable to separate all bicycle and moped traffic on stretches of road with large flows of cyclists and moped riders.

**Safe pedestrian, bicycle and moped crossings**

A pedestrian, bicycle and moped crossing is defined as safe, if it is a flyover (grade separated) or if eighty-five per cent of motorists passes through by driving at a maximum speed of 30 km/h. The measure on pedestrian, bicycle and moped crossings is expected to have a high potential to reduce the number of cyclists killed.

Bicycle overpasses that are speed-secured and where motorists will give preference will increase the accessibility and safety of the cyclists. Unregulated bicycle crossings should, therefore, be replaced by...
bicycle overpass as long as it is possible. However, careful consideration is still required for when a bicycle overpass is suitable or not and how they should be designed to be effective. This condition means that it is crucial to continue the evaluation and development of the bicycle overpasses' design and application.

**Adaptation of the infrastructure based on requirements for safe cycling**

On the stretches of road between intersections, it is favourably safety-wise to physically separate cyclists from vehicles that differ with regards in speed, direction and mass. Different types of separation give different effects, and there are many factors, such as width, surface coating and detail design that may have a significant impact on cyclists' safety. Although separation on the road section leads to increased safety for cyclists along the route, it can as well lead to the cyclists' safety at crossings decreasing. Therefore, adequately designed and speed guaranteed crossing points are required.

The bicycle infrastructure, where class II moped also travels, is sometimes flawed design with excessive curves, steep slopes, high kerbstones (curbs) and, permanent and temporary objects on or along the road. All this creates inconvenience for cyclists and moped riders both by limiting their accessibility and also posing a safety risk. Almost every fifth single-accident in which a cyclist is seriously injured can be related to such types of deficiencies in the design.

Continued improvement in infrastructure is therefore required, removing unnecessary obstacles and adjusting the design based on the conditions and needs of cyclists and moped riders. Also, safe side-areas are necessary. The mindset used in the vision zero work with safe side-areas along motorways should also be applied to the bicycle infrastructure.

In case of new construction of a road, the construction requires some parameters. Of these parameters, it is likely that smoothness and friction are of the most vital importance for the safety and accessibility of cyclists. Often the same requirements are imposed on a bicycle path as on a motorway. The reason for this is that the bicycle path should have the same standard as the adjacent-motorway to prevent cyclists from choosing to ride on the road instead.

The problem is that the measurements and measurement methods developed to define the standard requirements are also designed based on car traffic, which does not necessarily match the cyclists’ preferences and needs. Requirements and follow-up methods for bicycle paths need to be reviewed concerning the comfort, accessibility and safety of road users who make use of the road. More research and development is required here.

**Speed differentiation on bicycle paths**

The current rules for speed on the bicycle track are the same speed limit as for the adjacent carriageway. In the case of detached bicycle roads, the base speed for urban areas is instead applicable, which is now 50 km/h.

Because all various types of vehicles and road users use the bicycle infrastructure, it may lead to the risk of higher speeds and increased speed differences, which in turn may lead to a new safety and security issue. To be able to avoid this, a more functional and speed-differentiated bicycle road network is required. On specific road stretches, it may be appropriate to limit speed through local traffic regulations and road signs or limit it in another way. However, it needs to be investigated more closely as to how the needs look and when and in what way this can be done.

**Conscious decisions about where mopeds are best conveyed**

Mixing mopeds' riding and walking on the same paths creates insecurity and disturbances - especially for children, the elderly and the disabled. This circumstance is a problem that occurs mainly in urban areas with many pedestrians. The decisions on where vehicles are to be conveyed are in most cases already taken in the planning phase for new construction or in the revision of different plans. At this stage, it is crucial to take into account what arrangements are being made for different areas to be used for, and which vehicles will then use the area.
Designing the infrastructure so that it does not comply with the intentions of the plan should be avoided as far as possible.

Class II mopeds (25 km/h) should use pedestrian, bicycle and moped paths. However, concerning where class I mopeds (45 km/h), as well as other slow-moving vehicles, are to be best conveyed in different traffic environments, there is need to be conscious on which decisions are made because they can not be conveyed on pedestrian, bicycle and moped tracks. On specific road stretches, it is desirable that these vehicles be offered a different custom roadway to travel because the option may lead to higher risks. For example, if there are pedestrian, bicycle and the moped path along a highway (high-speed road), class I mopeds does not use the pedestrian, bicycle and moped path. Moped riders are many times kid or adolescents, and it is crucial to create a safe and secure place for both moped riders, cyclists and pedestrians.

### 5.1.2 Continued research and development

Further research is required, to develop a constructive relationship that describes how the design of cycling infrastructure affects the accessibility and safety of cyclists and moped riders. Particularly essential are pre- and post-studies, where there is a systematical and scientifical evaluation of measures implemented. There is a need for increased cooperation between road authorities and academics, for improved exchange of experience and long-term knowledge building.

Examples of questions are how to design safe and accessible intersections, how to choose the coating, how to ensure the smoothness and friction of bicycle paths, the suitable road markings and how to define safe side-areas for cyclists and moped riders. Continued development of measurement and measurement methods based on cyclists’ conditions and needs is also required.
There is also a great potential in using model-generated flows to calculate risks, and hopefully, more cities will start using today’s traffic models for the bicycle traffic. It is imperative to continue developing the models to improve flow data, and we want to see more comparisons of measured data from bicycle countings. Another important aspect is that the bicycle road network used in the models is as comprehensive as possible.

The investigation of self-driving vehicles on the road (SOU 2018:16) mentions the proposal that automated class II moped as a new vehicle type that would be conveyed on a bicycle path. If the rules are introduced, there is a need to develop an approach to these types of vehicles.

5.1.3 Roles and responsibilities
Road authorities, mainly municipalities and the Swedish Transport Administration, are responsible for planning, building and maintaining the road infrastructure. Other actors in society also play a significant role in the ability to influence the design of infrastructure. These include mainly private-road authorities, property owners, county planners, the Swedish Transport Agency (Transportstyrelse), the Swedish National Board of Housing, Building and Planning (Boverket) and Swedish Association of Local Authorities and Regions (Sveriges Kommuner och Landsting - SKL).

Even architects, physical planners and traffic planners at municipalities and hired consultants in practice have significant influence over structure, design, conformation and choice of material in connection with infrastructure rebuilding. Research institutes, universities and colleges, in collaboration with previously mentioned actors, have a responsibility to develop knowledge bases, such as connection effects, as guidance in designing the infrastructure.

The considerations that are made in connection with the design of infrastructure and the traffic environment significantly affect safety, both single-accidents and conflict-accidents involving vehicle traffic. Considerations also have significance for accessibility and availability. To create a safe environment, the safety of active and unprotected road users should be a crucial starting point already in the planning process earlier, for the new- and reconstruction of housing, squares, streets and other environments where unprotected road users travel and reside. The considerations made in connection with the new- and restoration of the housing of different environments also affect the conditions for road and street operation and maintenance, and their side-areas, which in turn are essential for safety and attractiveness.

Since the year 2013, the Swedish Transport Agency has been authorised under the Planning and Building Ordinance (2011:338) to provide technical quality requirements for all roads and streets. As part of the regulatory development framework that is ongoing, as a result of this authorisation, the consequences of possible requirements and general advice for improved safety for cyclists and pedestrians are analysed and investigated. The regulations will apply to new building and rebuilding and then during the economic life-span of the roads or streets.

The Swedish Transport Agency is authorised to issue further regulations to the Traffic Regulations (1998:1276) and the Road Signs Regulation (2007:90). For example, the Swedish Transport Agency give rules and general advice on how specific traffic rules should be designed by local traffic regulations to be clear and legal. The Swedish Transport Agency also announces detailed regulations on road signs and other devices, and, among others, where road signs should be set up.

5.2 Good quality operation and maintenance
Bearing in mind that factors related to operation and maintenance are a contributing factor to so much of the part of single-casualties leading to seriously injured cyclists, it is vital to be improving the management of the cycling infrastructure. Lack of operation and maintenance can also have an indirect impact on safety by distracting cyclists and moped riders so that they do not pay full attention to other road users.
An advantage of increasing the operation and maintenance input for cyclists is that it promotes both targets of increased and safe cycling - there is no target conflict. Also, an improved operating and maintenance standard on the bicycle infrastructure favours all the unprotected road user groups travelling there, of all ages, and both men and women. Operation and maintenance of the cycling infrastructure thus have significance for several of the transport policy considerations and can give significant socio-economic gains.

There is a high potential for reducing the number of single casualties by preventing, in particular, the occurrence of slippage, although that type of accident cannot entirely be eliminated. In the first place, winter road maintenance needs to be improved to reduce the risk of slipping due to ice and snow, but even under proper conditions, good maintenance is required, see figure.

In recent years, slipping-control-with-salt on bicycle roads have become increasingly common. In particular, the method that is known as "sweep-salting" has been applied to a significant extent. The method means that a garbage roll is used to wipe off snow from the road surface, and to combat the slipperiness with saline-solution or moist salt. The technique has been used for winter road maintenance of bicycle paths in Linköping since the year 1999 and has recently been used in about twenty-five municipalities in Sweden. With the method it is possible to achieve a higher winter operating standard, thus improving the accessibility, comfort and safety of cyclists during the winter.

However, like all methods, even sweep-salting has its limitations and shortcomings. As long as the drivers are out in time, the snowfall does not get too heavy or the temperature too low, and usually the sweep-salt works well as a disposal method. Otherwise, there is a risk that ice is formed which can be challenging to remove with only brush and salt. Further development of vehicles, equipment and strategies is a necessity for the sweep-salt method to achieve a more optimal application.

The design of the bicycle path and the road surface condition can also affect which result is achieved in winter road maintenance. For example, it is challenging to maintain winter roads with narrow crossings, design details, irregularities and damage in the coating where snow and ice can accumulate. The location of wells and the slope of the roadway also affects the runoff, and thus the risk of slipping will occur.

Even in winter road maintenance, the standard requirements are often the same for bicycle roads as for nearby motor highway, to prevent cyclists from choosing to ride on the roadways instead. The problem with it is, however, is that with the same standard requirements on the bicycle path as on the motorway, the motor roadway will almost always offer a better standard. The reason for this is that car traffic helps to remove snow and ice from the road surface while bicycle traffic does not.

One of the benefits of sweep-salting is to clear the remaining gravel from winter-sanding that can cause both rollovers and punctured bicycle tyres among cyclists. If sanding is chosen instead, it is essential to pick up the sand as early as possible by the end of the winter. Generally, cycling roads need more or less regularly to be sweep-cleaned from gravel, leaves and others that can cause single accidents. Other crashes related to the ground can be connected to bumps, dips, potholes and other irregularities in the roadway.
5.2.1 Important efforts
Damage to the coating, slip, dirt, gravel or temporary objects on the bicycle path requires swift action all year round to reduce the risk of cyclists being injured. Therefore, improved routines and tools are needed to detect deficiencies on the road surface early. Maintenance plans are also required to fix the shortcomings or even to avoid them from occurring.

Strategies, resources and equipment that are adapted for the operation and maintenance of the roadway network are not always optimal for the management of bicycle paths. A more regular inspection, operation and maintenance of the bicycle road network, which can be operated with fewer vehicles and hand tools, has the potential to improve the standard and thus reduce the number of accidents. Organisation, planning and coordination between the road authorities are also essential to streamline the operation and maintenance of bicycle paths.

5.2.2 Continued research and development
The effect relationships for different operation and maintenance measures need to be developed, in the same way as for design. Such effect relationship can, for example, be developed through pre- and post-studies.

As interest in winter cycling increases, there is also a need for increased knowledge of the friction requirements to be set and how to monitor it and what measurement methods to use. Continued application of sweep-salting requires increased knowledge about the processes of salting on the bicycle path, which differs significantly from those on the roadway. Also, further development of vehicles and equipment is required for a more optimal application. Both more effective brushes and better-suited salt spreaders are needed. There is also reason to study the different types of coating slipping tendency under different conditions, as it has been found that the coating in itself affects the risk of slipping to occur. The comparative studies of various slippery combating means would also be valuable, preferably from an overall perspective concerning impact, cost and environment.

5.2.3 Roles and responsibilities
Road authorities naturally have the ultimate responsibility for maintaining a good quality of operation and maintenance of the bicycle road network. In other words, the Swedish Transport Administration, municipalities and property owners are the most important actors.

For a cyclist, it is crucial to have a consistent standard level throughout the cycling distance. With different road authorities on the same bicycle paths, there may be significant variations in the standard. Therefore, road authorities also have a responsibility to cooperate to achieve as far as possible a consistent standard along the bicycle path. In this coordination, regions can also play an important role.

Research institutes, universities and colleges, in collaboration with the actors as mentioned earlier, also have a responsibility to develop knowledge bases, such as effect out-turns, as guidance in selecting standard requirements, strategies and methods for operating and maintaining the infrastructure.

5.3 Safe bicycles and mopeds
5.3.1 Safe bicycles
For a bicycle to be sold, it should be considered to be safe according to the Product Safety Act. Under the joint product safety legislation in the EU, harmonised standards for different bicycles and bicycle products have been developed. If the bicycle or bicycle product meets the requirements set in the appropriate standard, it is considered to be a sufficiently
safe product. The manufacturer may also choose to show otherwise that the product meets the particular requirements set out in the harmonised standards.

The Swedish Transport Agency has conducted market checks on bicycle products after the EU standards were established. This event has resulted in the awareness of which the actors in the bicycle industry have raised the strength requirements and more imposed on these products. Many manufacturers today purchase components and entire bicycles made in Asia, and in the procurement documentation they have the condition that the product complies with EU standards and that this must be verified with a test report. However, there is no requirement for CE-marking for these products.

The design of the bicycle also affects the risk of crashes in connection with getting on and dismounting from the bicycle, especially for the elderly cyclists. There are three-wheel bicycles for the elderly and disabled. They are easier to keep the balance at lower speeds, but instead get stability problems at higher speed rates, especially where there are curves.

The bicycle or cyclist's interaction with the bicycle has been the ultimate underlying cause in 16 per cent of single-casualties. To achieve stability, specific speed is required for the bicycle - at low-speed rates, it is challenging to keep the balance. Research and development of gyron systems are currently underway to help the cyclist keep the balance at low speeds.

Well-functioning brakes are a prerequisite for safe cycling. Studies have shown that there are apparent differences in the stopping distance between different bicycle types with various design and variations in braking systems. In a test under controlled conditions, for example, a lady-bicycle with foot brake had the longest stopping distance. The hybrid bicycle with hydraulic disc brakes has the shortest braking distance. The importance of the brakes for the safety of cyclists is evident by the fact that many cyclists have been seriously injured when the handbrake grip becomes too hard. Development is, therefore, made for brakes where the braking force is increased gradually or is lock-free (ABS). Tests at VTI have shown that a similar effect with ABS-brake on a bicycle as on motorcycles can be achieved, where a reduced risk of a rollover in case of braking with ABS-brake could be demonstrated.

It is not only the brakes which are important for effective braking but also the grip between the tyres and the roadway. Particularly in the winter time, many bicycle crashes occur as a result of lost road-grip. Therefore, it is worth recommending cyclists to use the studded tyres for cycling on winter roads. Studies from VTI have shown that although there are significant differences in ice grip between different types of studded tyres, they have better grip than unstudded bicycle tyres. It's not so easy that more studs automatically means a better ice grip, without the tyre's rubber mix, and studs-design is also essential.
Today, trim products are marketed for electric bicycles. All forms of “trimming” of electric bicycles are illegal in road traffic. Trimming is associated with serious safety risks since the mechanical design of the electric bicycle and its components are not designed to be converted for propulsion with electrical assistance at speeds beyond the prescription by the manufacturer for each class of electric vehicles.

Changing the engine’s function to make the vehicle stronger or moving at a higher speed may in some cases lead to the vehicle ending in another vehicle class or vehicle category. This condition may imply, among others, that other requirements are imposed on the use of that vehicle, such as jurisdiction.

5.3.2 Important efforts for safe bicycles

“Improper use” and trimming of electric bicycles need to be prevented. The Swedish Transport Agency receives and follows up reports from citizens regarding dangerous products. They also get information about dangerous products that the other EU-Member States have noted, through a system administered by the EU-Commission. If the products do not prove safe, the authority takes action to protect consumers. The level of safety described then is the absolute minimum safety level needed to sell a bicycle. Bicycle traders also have an essential part in limiting the trimming possibilities. Measures taken regarding moped trimming have been successful. It is essential to develop similar measures to prevent trimming of the electric bicycle.

One possible measure to prevent misuse may be to demand to trade through some form of “delivery protocol” on the sale of electric bicycles.

Authorities, municipalities and companies should have a policy on bicycles that may be of use in the service. The requirements should be dynamic for the possible achievement of continuous improvement.

5.3.3 Continued research and development for safe bicycles

These questions are essential to increase knowledge about:

- How does the development of injuries look like in connection with electric bicycles? The understanding of fatalities and injuries associated with electric bicycles needs to increase. The strategy will need to be able to be followed over time.
- What is the right winter tyre for a bicycle? Knowledge of what is a right winter tyre for bicycle and how to best use it needs to increase as well as comprehension about how the user can improve.
- What is the effect of ABS on a bicycle? Knowledge of the impacts of new support systems, such as lock-free brakes, needs to increase.
- How can stability increase for bicycles? Currently, injuries also occur even when stagnant (in case of fall from getting on and demounting) and on a journey at low speed.
- How can the use of bicycle lighting increase? Research from Denmark shows that crashes between cyclists and other road users decrease when the bicycle is equipped with permanent lighting, even in daytime (Madsen et al. 2013).
- How comprehensive is the trimming of electric bicycles and what opportunities are given today for trimming? Knowledge about the extent and consequences of trimming on electric bicycles needs to increase. The knowledge about how the market contributes to trimming also needs to improve. Currently, we know that the internet offers opportunities to increase both the power and the speed of electric bicycles. We also need to know if bicycle vendors contribute to the trimming of electric bicycles.
- Where do the electric cyclists come from, and how does the travel trend look like on an electric bicycle? The knowledge about who can begin cycling with electric bicycle needs to increase. Although there is a good basis for electric bicycle sales in Sweden, there is not much informa-
tion about the use of electric bicycles (so-called exposure data). Travel habits data (RVU data) usually do not report electric bicycle as its means, and neither does STRADA data. Cycling measurement points (e.g. bicycle barometers) also cannot distinguish electric bicycles from regular bicycles. Thus, there is no information about who rides on electric bicycles, and how, when and why.

- How can cyclists be integrated with new information systems that are now mainly developed for cars? Cars will be to a more significant extent, increasingly be able to communicate with each other. The question is how cyclists can best be integrated and benefit from such systems.
- How can a market-based bicycle safety test be developed? Euro NCAP has had a decisive effect on the development of safer cars. It would be essential to examine the possibilities of developing a similar model for bicycles, a voluntary test that promotes suitable bicycles on the market. (Spolander & Unge 2013).

5.3.4 Roles and responsibilities for safe bicycles
The Swedish Transport Agency has an authority responsibility. The product-specific bicycles standards are being developed continuously, including improving safety, among others. Recently, European standards have been replaced by global ISO standards. An advantage of this is that the production for specific markets in the long term decreases and that manufacturer have to relate to fewer rules. The bicycle traders also have a responsibility for the bicycles being sold to meet the requirements that are imposed.

According to new EU regulations, a “motorised bicycle” must be approved in the EU from 1 January 2016. In Sweden, the motorised bicycle is classified as a class II moped. A motorised bicycle shall be designed to be operated by a pedal- and crank device and shall not provide power surcharges at speeds of more than 25 km/h. The net power of the engine must not exceed 1 kilowatt. Bicycle helmets are enough to drive just this type of moped.

Reduced opportunity for trim and technical shortcomings.
There are requirements for measures to reduce the possibility of trimming in connection with the approval type. The requirement means that the vehicle manufacturer must counteract and make the ability to change the constructive speed of the vehicle to be more complicated. There is also a requirement that the moped should be fitted with a sign indicating the maximum constructive speed. The approval type requirements for trimming are directed exclusively to the vehicle manufacturers.

There is a great potential in reducing the number of moped crashes caused by the moped being trimmed or having technical shortcomings. As seen in the statistics for killed moped riders in the year 2012-2014, there is potential for four fewer deaths. The Swedish Transport Administration’s analysis of fatal crashes (2005-2013) shows that only 3 out of 10 mopeds involved in fatal crashes were without known technical shortcomings. At least every fourth moped involved in a deadly accident was trimmed. In fatal crashes where the driver was under 18 years, at least half

5.3.5 Safe mopeds
Currently, there are two moped classes:

Class I moped: A two, three or a four-wheeled motor vehicle designed for a speed of 45 km/h at the highest.

Class II moped: A two, three or a four-wheel motor vehicle designed for a speed not exceeding 25 km/h and whose power does not exceed 1,000 watts. The previously nationally approved 30 km/h moped belongs to class II moped.
of the mopeds were trimmed. Trimming does not have to lie behind the occurrence of the crash, but it definitely affects the severity of the injury because the speed may be higher when the crash occurs. In addition to trimming, there were also other technical flaws in the moped in connection with fatal accidents, such as lack of lighting and braking. Such deficiencies are also essential to work with continuously.

There is a need to develop methods that enable more effective monitoring, as it is today very resource-intensive. The proportion of trimmed mopeds found in connection with fatal crashes has decreased, but there is still a large proportion of mopeds that have been trimmed or had other technical flaws in the event of fatal accidents.

NTF’s 2015 survey of 673 students in grade 9 in eight schools spread across the country shows that over 25 per cent of young moped riders still often or quite often drive too fast (34 per cent of boys and 21 per cent of girls). Two-thirds say that the moped runs over 51 km/h and one third that it exceeds 61 km/h. A fifth of the mopeds is reported to exceed 71 km/h.

It is twenty-eight per cent that allows the moped to be trimmed (39 per cent of boys and thirteen per cent of girls), while ten per cent does not know. Most common is that of the buying a trimmed moped (32 per cent) or trimmed individually (28 per cent). It is sixteen per cent which has been helped by a friend to trim the moped, fourteen per cent by a parent, and five per cent by a moped dealer. Over eighty per cent of the youngsters with a trimmed moped answer that their parents know about it.

For a moped to be put into service, it must have approval for this purpose. Such approval may either be an EU approval-type or be done through a national registration inspection (for class I moped) or national moped inspection (for class II moped).

An EU approval-type for vehicles means that a Member State confirms that a vehicle type meets the requirements of the EU legislation. The vehicle manufacturer confirms with a certificate that the vehicle with the indicated identification number complies with the approved vehicle type. The technical and administrative requirements for EU approval-type are harmonised, and the vehicles have free movement within the EU-community. This condition means that the Member States may not set additional requirements for the vehicles to be marketed, registered and used. On used mopeds of later years model, it is difficult to check if the vehicle has been trimmed. In the global market through, among others, the internet trade, it is challenging today to prevent trimming products from reaching the Swedish market.

5.3.6 Important efforts for safe mopeds

Parents role

Previous studies have shown that parents have an essential role to play in the youth’s perceptions, attitudes, norms and behaviours associated with moped driving. In general, the results of a VTI study showed that there was no mention of many conversations about moped driving, which could be linked to the firm belief that the teenager already had
sufficient knowledge and acted right. Nevertheless, there was an absolute difference between mothers and fathers. While the mothers stated that they were more concerned and that they talked more often to their children about the high-speed risk, the dads felt greater acceptance for high speeds. The results also showed that the girls were considered by the parents to be safer in traffic, but despite this, the girls had more restrictions compared to the boys.

**Measures addressed to traders and policy holders**

NTF cooperates with Sweden's Motorcycle Dealers' Association (SMR) and the Bicycle, Motor and Sports Traders (CMS) to counter the trimming of mopeds. There's an established agreement between the sole trader and NTF, where the trader guarantees not to sell trimmed parts or trimmed mopeds and does not trim or otherwise assist in trimming of mopeds. In this way, the trader actively takes a stand against trimming. Even McRF has participated in the cooperation to counteract trade in trimmed parts. They have clearly taken a position against providing trimmed parts and demanding their members not to offer trimmed parts. For example, the supplier and the workshops may question the warranty if the moped is trimmed. The insurance companies do not replace the mopeds where there are speed-raising components on mopeds. It has been shown that the one who has the financial interest (parent) of the moped is more careful that the trimming of the moped does not happen.

**Other measures**

From 1 January 2016, it is not allowed to drive a class I moped at speeds higher than 45 km/h, as it is for its design. Nevertheless, it is not unusual for Class I mopeds to move faster than that. One reason is that they are trimmed, but it also happens that mopeds without trimming go faster than the speed for the level they should require in its design.

The new special speed limit for class I moped was introduced to increase safety by reducing the possibility to drive faster than 45 km/h. The background is that many have been severely injured or killed on a moped over the last few years, and sometimes it can be difficult for the police to determine if the moped is trimmed or not. In addition to checking the trimming, by now the police can also report speeding over 45 km/h, increasing the ability to keep the mopeds from not running faster than expected.

**Training for driving licenses and moped driver’s license**

To increase road safety, the rules to drive class I and class II moped as of October 01, 2009 has changed. There was an introduction of a new driving license competence (AM-rating), and it is required to start driving class I moped. It also applies to the fast-electric bicycle. At the same time, it is necessary to take a driver’s license to get started driving the class II moped, including the motorised bicycle. Driver’s license and moped driving license can be revoked after the breach of trimming.

VTI has evaluated the effect of the AM-education. In summary, the minor effects of the AM-education were noted on risk behaviours and attitudes towards these behaviours, while the education was perceived by many as useful. One possible explanation is that the risk awareness and self-evaluation aspect has not been achieved and that the focus is still on knowledge and rules despite the new syllabus.
5.3.7 Continued research and development for safe mopeds
It is by the police resource-demand to check if a moped is trimmed. It is also challenging to prevent trimming products from reaching the Swedish market, with the global market of today. There are currently no obstacles to selling these products, and they can also be used on vehicles in certain areas, for example within a fenced motorway. There is, therefore, a need to develop methods that enable more effective monitoring but also a need to be able to restrict access to the trimmed parts.

5.3.8 Role and responsibility for safe mopeds
In every EU country, there is an approval-type authority that may issue a type of approval. This condition means that the authority issues a certificate that allows the manufacturer to sell the moped in the entire EU without further testing. The approval-type authority shall also check during manufacture that the product continues to meet the applicable requirements.

In Sweden, the Swedish Transport Agency is the approval-type authority for mopeds. The Swedish Transport Agency is also the supervisory authority for the Product Safety Act (2004: 451) for mopeds. The role of supervisory authority according to the Product Safety Act includes, among others, receiving and following up complaints regarding product safety. The ability to issue injunctions, prohibition and penalty are available as tools under the Product Safety Act, to ensure that only safe products are marketed. The Swedish Transport Agency may also issue regulations on mopeds requirements.

5.4 Safe passenger cars and heavy vehicles
Passenger cars, trucks and buses are often involved in crashes that cause the most serious injuries, as well as deaths among cyclists and moped riders. To influence the characteristics of the vehicles when interacting with unprotected road users in the traffic is therefore of great importance. Furthermore, it is necessary to follow the technology development to be able to assess the extent to which other characteristics of the traffic system can be adapted for maximum potential benefit.
5.4.1 Heavy vehicles
There are great opportunities to improve the features of buses and trucks in the interaction with unprotected road users. It could be a better view from the driver’s seat, also with other technical aids that help to perceive the unprotected around the vehicle. This opportunity is relatively well-known, and there is a development of these vehicles in progress.

The systems currently in passenger cars as of today, such as emergency brakes for unprotected road users, have not yet been introduced on a larger scale in heavier vehicles. There is a need for development and implementation. The requirements that exist on the front of passenger cars, to be law friendly for unprotected road users are missing for heavy vehicles. There are good reasons to strive for improvement, not least for city buses that often run in mixed traffic. For virtually all new efforts, it is essential that the vehicle speeds are at a level that makes it possible for the systems to function.

5.4.2 Important efforts for passenger car safety features
Over the last 20 years, Euro NCAP has succeeded in driving passenger cars safety forward in a focused and efficient manner. One could prevent many accidents or at least minimise the injury outcome utilising the widespread of advanced vehicle systems (especially Autonomous Emergency Braking and Autonomous Emergency Steering - AEB/AES). However, it is expected to take a long time before these advanced vehicle systems will spread widely within the Swedish car fleet, which indicates the importance of accelerating the implementation rate.

The development of new passenger cars means, among other things, that the design of the cars’ frontal is in such a way as to minimise the injury for a pedestrian when a collision occurs. Euro NCAP has since tested the launch of the crash-test program in passenger car’s ability to minimise injuries during a collision with pedestrians. A Swedish study has shown that the risk of severe injuries is reduced by thirty-eight per cent when cars range from 1-star to 2-star Euro NCAP performance.

However, the car’s protective ability decreases at higher speeds. An increasing number of passenger cars are therefore equipped with technical emergency braking systems that automatically intervene when a crash is inevitable. The first systems focused on rear-end collisions. At present, there are also systems that can activate braking for both cyclists and pedestrians. These systems can both reduce the rate of impacts and reduce the force in cases where avoiding a collision is inevitable. Starting in 2018, Euro NCAP will test and grade the car’s emergency brake for pedestrians and cyclists. The performance will be important for the overall rating of cars. In spring 2018, the European Commission will present a proposal for a new act on general safety requirements for cars.

The act entails new requirements for the vehicles, which will increase the protection of both the vehicle occupants and the road users outside the vehicle. There will also be proposals for several measures to improve the safety of unprotected road users, in addition to those introduced by the new act. These measures will be introduced gradually and apply to new vehicle-types. The measures proposed and which are linked to unprotected road users are:

- Autonomous Emergency Braking System. Is available in the present day for heavy vehicles but also introduced for light vehicles. In the first
place, these should mitigate or prevent collisions in highroad traffic situations. Autonomous emergency braking systems can detect pedestrians from September 1, 2024, and cyclists from September 1, 2026.

- Rear camera or back detection. Introduced for all cars and heavy trailer-vehicles. To be introduced from September 1, 2020.

- Strong requirements for the design of windscreen and A-pillar. The requirements aim to reduce head injury in case of collisions.

- Side protection on heavy vehicles. Strengthening of side protection requirements for trucks and heavy trailer-vehicles. To be introduced from September 1, 2020.

- "Blind spot" - detection. System for heavy vehicles wide right-turn, which will warn the driver if a cyclist or pedestrian is located next to the vehicle.

5.4.3 Continued research and development
The technology of primarily passenger cars, buses and trucks should also be developed to prevent unprotected road users from getting hit when the vehicles turn or reverse. For example, it concerns the design of the front-environment for better visibility and the development of better rearview mirrors and warning-systems that partly help the driver to act correctly, and somewhat increases the ability of unprotected road users to pay attention to vehicles and their movements. The interaction between unprotected and autonomous vehicles (e.g. at a pedestrian-crossing) needs to be explored to avoid conflicts that may have serious consequences. In general, collision-force needs to be reduced by changing the design of the vehicles and the traffic environment. The design of the cars should be more adapted to protect unprotected road users by making cars more shock absorbing. Studies on the effect connected to the vehicle system are essential to highlight which systems will be effective in the future.

5.4.4 Roles and responsibilities
A majority of traffic volume is generated by newer cars. On average, just over half of the car’s total mileage runs during the first seven years of the car (Source SCB). Companies or authorities purchase over sixty per cent of all new cars. It is crucial to encourage authorities, municipalities and companies to choose safe and fuel-efficient vehicles, to control the inflow of new vehicles. Authorities, municipalities and companies should have a policy on vehicles that may be of use in the service. The requirements should be dynamic so that continuous improvement is achieved.

Sweden has for many years been an active and driving party in Euro NCAP. Continuing membership provides opportunities for a further push to ensure the safety assessment of the unprotected road users. Euro NCAP, in turn, helps to motivate car manufacturers and their suppliers to focus on essential safety areas. So far, Euro NCAP’s basic strategy - using market forces - has been hugely successful.

5.5 Increased use of helmet and other protective equipment
Head injury is the most common injury that causes the death of cyclists, regardless of the type of accident. Almost half of the very seriously injured cyclists suffered a head injury. Sixty-eight per cent of all head injuries occur in single-accidents, that is when cyclists role-over without involvement by anyone else. Less than one-fifth of all head injuries occur in a collision with a motor vehicle, and these crashes usually result in more serious head injuries. From the look at all seriously injured cyclists, the most common injury is to the arm and shoulder, followed by leg- and hip injury.

The bicycle helmet halves the risk of head injury
Several studies based on actual crashes show that cycling helmets are of great importance. Bicycle helmets reduce the risk of head injury by at least fifty per cent (Olivier & Creighton 2017).

Swedish research shows that avoiding two out of three serious head injuries is possible if the cyclist uses a helmet (Folksam 2013). The number of fatalities could be reduced by twenty-five per cent if everyone used bicycle helmets - for severely and seriously inju-
red, the corresponding proportion is five and twenty-five per cent respectively.

**The bicycle helmets are one of the preconditions for safe cycling**

To achieve the vision zero for cyclists, the cyclists need to use a helmet. The helmet is as vital for the cyclist as the seat belt is for the car driver. In both cases, it is a crucial safety component that slows down the stroke in case of an accident that would otherwise lead to death or serious health problem, a safety component that cannot be replaced by any other measure. A prerequisite for getting a road transport system that is both safe and attractive to cyclists is that cyclists use the helmet.

Previous studies have shown that the combination of the lower speed limit, helmet, friendlier car front and autonomous braking can provide up to ninety-five per cent reduction of invalidating injuries that occur in a collision with passenger cars (Ohlin et al. 2017).

![Helmet's protection effect](image)

The present-day's helmets are effective in preventing serious head injury. There are good examples of innovative protective equipment such as helmets with rotations' protection and a bicycle helmet in the form of a collar containing an airbag inflated and protecting the head in any case of an accident.
Bicycle helmets use
By the year 2017, the observed cycling helmet usage was 44.2 per cent, which is an increase of almost nine percentage points since the year 2016 when the level was 35.6 per cent. The figure in section 4.5.3 also shows how cycling helmet usage needs to change between the year 2007 and 2020 to achieve the seventy per cent target. This occurrence means an annual increase of 7.6 per cent. The proportion of cyclists using helmets, on average, between the year 2010 and 2013 has followed the increase rate but stopped by 2014. By the year 2016, a decrease was noted, then increased in use again in 2017.

The bicycle helmets usage in Sweden is on a reasonably modest level, especially for adults, and there is a great potential to increase the proportion of bicycle helmets users. The figure shows that the observed bicycle helmet usage in the year 2017 was eighty-five per cent for children up to 10 years in residential areas, and sixty-seven per cent for children 6-15 years cycling to and from school. For adults, cycling helmet usage is significantly lower: In the year 2017, it was thirty-seven per cent on travels to and from work and forty per cent on public bicycle routes.

There are relatively significant changes between the year 2016 and 2017 - among all age groups, the helmet use increased in 2017. However, this is after a decrease for several of the groups that occurred between the year 2015 and 2016 in connection with the exchange of measurement contractors. Between the year 2016 and 2017, helmet usage has increased for all categories. For older nine-year (compulsory) school pupils going to high school, helmet use had increased from thirty per cent in the year 2016 to forty-eight per cent in 2017, which is approximately the same level as in 2015 when forty-four per cent had a helmet. For school children at the elementary-level (7-10 years-olds) and intermediate-level (10-13 years-olds), the use of helmets has increased from seventy-four to eighty per cent between the year 2016 and 2017.

NTF annually performs measurements of helmet use among cyclists and moped riders in all municipalities in the country
The result from the spring of the year 2017 report shows that forty-four per cent of cyclists used the helmets and ninety-eight per cent of moped riders. The number of cyclists observed was 111,694, and the number of moped riders observed was 7,322. In the case of bicycles, fifty-eight per cent of the children and thirty-four per cent of the adults are using helmets.

The geographical differences are vast. The highest use of bicycle helmets is in Stockholm county with sixty-eight per cent, then Jämtland county with fifty-eight per cent and Västernorrland county with fifty-seven per cent. The lowest use of bicycle helmets is in Gotland county with twenty-eight per cent, then Uppsala county with twenty-nine per cent and Västmanland county with twenty-nine per cent.

The geographic differences are also significant concerning moped helmets usage. In several counties, the usage is hundred per cent, while ninety-four per cent used moped helmets in Gävleborg and Kalmar county, which are the lowest numbers in the country.

Overall, the bicycle helmets usage is far from the seventy per cent target level for the year 2020, which is one of the road safety indicators that aim to reach the national target of fatalities and seriously injured in the traffic.
Bicycle helmet law and its impact on cycling
On this present-day, twenty-seven countries have some specific bicycle helmet law. A literature study commissioned by the Swedish Transport Administration to obtain an up-to-date knowledge on the summary of the impact of a bicycle helmet law shows that it is difficult to draw any definite conclusions from the results of the made evaluations. Overall, the study showed a mixed result. Thirteen studies showed no change in cycling after the introduction of the bicycle helmet law. Two studies showed reduced cycling and eight studies showed a mixed result (both increased and decreased cycling). Given the knowledge reported in the literature study, on the present-day, we cannot see a clear connection between the introduction of helmet law and a reduction in cycling.

Bicycle helmets law for children under fifteen years in Sweden were introduced on January 1, 2005. Since the year 2000, the Swedish Transport Administration (and the Swedish Road Administration, before 2010) has conducted a survey every three years on how children go to school. The surveys show that a more significant proportion of children aged 6-12 years ride a bicycle to school in the year 2015 compared with the year 2000. Therefore, based on this basis, there can be no reduction of children cycling to school shown since the introduction of the helmet law.

Acceptance for bicycle helmet requirements increases
According to the Swedish Transport Administration’s road safety survey, the acceptance of a bicycle helmet law has increased overall between the year 2015 and 2017. In the year 2015, sixty-two per cent of respondents were in support of compulsory helmets use, and in the year 2017, it was sixty-seven per cent.

Other protective equipment (PPE)
Although bicycle helmets are regarded to be the essential protective equipment for cyclists, there is other distinctive protective equipment that can also reduce the consequences of an accident or help prevent an accident from happening.

Based on the characteristic of bicycle accidents on shoulder injuries, we know that ninety per cent of the injuries occurs when there’s exposure of the shoulder to a direct impact on the ground, which in turn suggests that shoulder protection could reduce the number of such injuries. There is, therefore, a need to design body protection for cyclists. If all cyclists make use of arms and leg protection, the number of serious injuries could be reduced by thirty per cent. About fifteen per cent of the injuries would be avoided if the protective effect was the same as for bicycle helmets. (Folksam 2013).

Many cyclists use safety-clothes, such as reflex vests, or other visibility equipment as a complement to the bicycle’s equipment. Research from Denmark shows that yellow bicycle-jackets with reflexes can reduce crashes between cyclists and other road users by up to thirty-eight per cent (Lahrmann et al. 2017). Visibility equipment that the cyclist wears, unlike the one mounted on the bicycle, is personal protective equipment, in the legislature sense, and must meet the requirements of EU standard legislation.

Increased and proper helmet use for moped riders
Helmet use is crucial to minimise the risk of suffering a serious head injury. In the year 2010-2017, forty-nine moped riders died, almost fifty per cent of these are without helmets or had lost their helmet at the time of the crash. Potential estimation starting from the year, 2012-2014 is at two fewer dead moped riders per year.

The figure below 4.5.4 shows the observed moped helmet usage in the year 2017. Only moped riders who are perceived to have the helmet firmly clamped are considered helmet users. The result shows that the observed moped helmet usage was ninety-eight per cent in the year 2017, compared to ninety-five per cent in 2016, which is an increase of three percentage points.

Earlier statistics show that almost forty per cent of all very seriously injured moped riders have suffered a head injury, while the corresponding share among the seriously injured is only ten per cent. Calculations show that the use of a helmet reduces the risk
of serious injury by seventeen per cent and severe injuries by forty-seven per cent.

By studying the distribution of the moped rider's injuries, by the degree of permanent physical impairment and by body part, it turns out that the head injuries account for a significantly higher proportion for those who were injured very seriously than for those who were seriously injured. It is, therefore, the same as for cyclists.

5.5.1 Important efforts

Bicycle helmet

In the present day, there is a law on using helmets for cyclists under the age of fifteen years. However, it is vital to work for the increase of cycling helmet usage for all cyclists.

Cajoma Consulting has made a study on increased cycling helmet usage, cyclists' driving forces and the Government's financial instruments in 2014.

The study shows that measures to voluntarily increase the use of bicycle helmets on the road have the highest chances of success in the following target groups:

1. **Commuter Cyclists.** In the case of commuter cyclists, it is essential to strengthening the already positive strategic matter on high helmet usage on the commuting route in the larger municipalities.

2. **Parents.** The insight about the importance of being good role models for their children on the matter of bicycle helmets usage may cause more parents to start using bicycle helmets. Reaching the parents can be done through childcare centres, preschools, elementary schools and parental associations.

3. **Elderly.** Older people are a growing group in the population, and elderly cyclists are a profoundly affected injured group of road users. Reaching the older people can be done through information and education initiatives aimed at the country’s five leading pensioner organisations. Older people are the target group that can be expected to increase there use of the helmet mostly up to the year 2020.

4. **Children.** A majority of children between the ages of 12-13 years will stop using helmets even though they are subject to a legal requirement. This target group needs a more explicit reminder in school about the importance of continuing the use of helmets. Research results underline the importance of combining a helmet law with information and education. Research has also shown the importance of friend’s helmet usage.

5. **Functionary Cyclists.** That is, employees in municipalities, county councils and companies that use a bicycle service officially during working hours, are a growing group for which the Work Environment Act can be a driving force for increased helmets usage.

Chapter 5.6 describes in more detail how behavioural interventions can be performed to achieve increased use of bicycle helmets.

Moped Helmet

A helmet is required for the driving of a moped. Information on the use of personal protective equipment is included in the mandatory training for moped drivers. The hope is that the training means an increase in awareness of the importance of using the helmet correctly and also that the use increases. One problem is that many moped riders today do not perceive that these crimes can lead to the revocation of driving license and driver's license. Probably they will be better at following the rules through awareness if this increases. Information on the legal consequences of a traffic offence is therefore desirable, for example, it can be identified clearly during driver training. Monitoring of current helmet requirements is also essential. See also 5.6 for behavioural interventions.

5.5.2 Continued research and development

Consumer tests show that the most significant difference between a good and a bad helmet is how well it protects the head from oblique strokes associated with the testing of helmets (Stigson, multiple 2017). Authorities and other Swedish actors, active in the
SIS TK 525 should, therefore, work to ensure that protection against obscuring strokes is included in the standards that provide presumption and are usually used in type-control. In the long run, this will result in all bicycle helmets being sold giving proper protection against an oblique stroke. There is also a need to develop attractive helmets that increase usage.

The design of today’s reflex vests and safety clothes are as a form of visibility, which means they are designed to maximise the visibility of a person without the need to get moving on the person. Studies have, however, shown that the design of visibility products that benefit from cyclists’ movements is significantly more efficient. Not only for the cyclist to be seen, but also to interpret the cyclist’s intentions. The standard currently available for safety clothes’ private use (EN 1150) is badly adapted for products that will show the user’s movement. Although standards in this area are always voluntary, it will be difficult in practice to get a vest that is optimised for motion approved. A revision of the EN 1150 is underway, and it is important that it be written in such a way that safety clothing adapted for cyclists and other road users in motion is included. The Swedish Standardisation Committee, TK 402, is working actively with the revision.

5.5.3 Roles and responsibilities
In connection with the government’s decision to relaunch New-start for the Vision Zero, the Swedish Transport Administration was commissioned to lead the coordination of road safety work in road traffic. The Swedish Transport Administration shall, among others, convene and engage in dialogue with the relevant authorities and actors as well as develop and spread the Vision Zero’s safety philosophy. The Swedish Transport Administration’s new responsibility means that the Swedish Transport Administration has been given an increased responsibility to develop knowledge and working methods that support effective work among the relevant authorities and actors for increased use of helmets and the development of new smart protection.

For helmets and other personal protective equipment for cyclists to be able to be sold on the European market, there is a requirement that these are type-controlled and CE-marked. Legislation has general requirements on the protective properties of the types of equipment, while detailed specifications are contained in standards referred to in the EU-journal, so-called harmonised standards. The only harmonised product standards available today, where cyclists are the target group, are standards for helmets (EN 1078 and EN 1080).

Most of the helmets sold in Sweden have been type-controlled with EN 1078 or EN 1080, where the shock absorption capabilities of the helmets are tested in a vertical stroke against the helmet. This action does not fully reflect the occurring accident’s loss in a bicycle crash. When a cyclist fall-over or gets hit by a car and strikes his or her head, the stroke is in principle always oblique to the ground or the car. The Swedish Standardisation Committee for Helmets (TK 525) is therefore actively working to influence and develop applicable standards so that the test method also includes the helmet’s ability to mitigate the rotation’s force. The Swedish Consumer Agency is the market’s control authority for helmets and other personal protective equipment for cyclists and works in addition to market control even with standardisation, regulatory issues and also to some extent with information to consumers and companies in the sector.

All actors have the opportunity to implement efforts to increase the use of helmets and other protective equipment individually or in collaboration within their respective areas of responsibility.

5.6 Behavioural interventions

Both cyclists and moped riders can influence their safety level themselves. It is therefore essential to also work with the behaviour of cyclists and moped riders.
5.6.1 Important efforts
• Cyclists’ use of helmet and other protective equipment, winter tyres, visibility equipment and trimming of electric bicycles.
• Cyclists’ rule compliance
• Moped riders’ helmet use, trimming and other technical shortcomings
• Increased involvement of parents towards young moped riders
• Motorists’ consideration of cyclists

5.6.2 Continued research and development
Research has shown that individual and social factors influence how people act in traffic. This revelation means that there are not enough technical solutions. Currently, there is excellent knowledge of how to conduct information campaigns on road safety, and therefore, it must be considered as a necessary measure. The problem with some of the campaigns previously implemented is that they have not been based on this knowledge and have therefore focused on the wrong things. That is, dealing with issues that are neither important to the individuals, nor affect their behaviour. Another problem is that rarely are any evaluations been carried out, which means that, not knowing if the campaign has succeeded or failed. There are guidelines for how a traffic safety information campaign should be designed, for example, in a manual from the EU-project Campaigns and Awareness Raising Strategies in Traffic Safety (CAST) (Delhomme et al., 2009).

The manual presents in much detail how the various steps in the campaign should be implemented. Below are some descriptions of the main elements:

**Identify and define the problem.**
The problem is identified using data on accidents, offences (observed or self-reported) and current events. In the present report several different problem areas have been defined, some of which involves cyclists’ collision with motor vehicles, cyclists’ single-casualties and the lack of use of bicycle helmets.

**Analysis of behaviour problem and definition of target groups**
Some behaviour problems can be identified among cyclists, moped riders and motorists. Cyclists fail, among others, in the use of bicycle helmets and compliance with regulations. Moped riders fail in the proper use of helmet and trimming of mopeds. For motorists, behaviour problems usually involve excee-
ding the standard/approved speed limits and lack of consideration towards cyclists and moped riders.

An important target group among cyclists is young people between the ages of 18 and 24 years, as their rule compliance is a major problem compared to other older age groups (Björklund et al., 2017). For moped riders, an important target group is those who trim and for motorists, those who do not respect speed limits in urban areas.

**Look into the motives behind the action.**
The next step is to investigate why target groups do not behave in a safe-traffic manner. The first question that should be asked is whether it depends on psychological factors, such as attitudes and norms, or if it is due to lack of knowledge.

If it is about psychological factors, it is important to use the Theory of Planned Behaviour because this can show which factors actually affect the behaviour. In a previous study that used the theory, it was found that what made them violate the rules was that they consider that it was light and rather harmless, but also that it was right to break the rules (Björklund et al., 2017). Being considered right and proper to violate the regulations can be explained by the fact that cycling is about moving from A to B easily, and that it will be fast (Forward, 2014). The study by Björklund et al. (2017) also showed that regular knowledge was relatively poor, especially when it was about rules that only apply in certain cases. However, it was even more common that they deliberately broke the rules than breaking the rules because of lack of knowledge.

It has also been investigated which factors affect helmet usage (Kazemi and Forward, 2009). If the usage of the helmet is experienced as relatively hassle-free, chances are higher that it is also used. Even the subjective norms plays-in; helmet usage increases if there are other users in the vicinity of the person using a helmet and trying to affect the person to use a helmet.

**Formulate the message**
The formulation of the message should be in such a way that the recipient is willing to process it actively. However, first, the individual must be curious enough so that he or she accepts the message. What drives the attention is people’s own needs and interests, and therefore, the target audience can instead be considered as the creature that is active than a passive recipient.

A common mistake is to try to increase the target group’s knowledge of the issue; that is, the message is aimed at the intellect. What is required is that the message also has an emotional signification. This requirement further reinforces the importance of understanding the target group’s motive behind the action.

Before launching the message, it should be tested on a similar target audience to which the message is to be directed. This action is to determine whether it has the intended effect: changed behaviours.

**Communication channels**
The target group for the campaign can be contacted both formally (e.g. via the media) or informally (for example, through workplace visits). Another example of an informal meeting may be to invite parents of young moped riders to participate on one or more occasions when their children undergo AM-education. Meta-analyses that investigated the impact of campaigns have shown that informal meetings often have a positive effect (Delhomme et al., 2009), which is probably due to the dialogue between intermediaries and recipients. The same meta-analysis also found that monitoring associated
with campaigns increases the effect. In addition to deciding how and where the communication should be conveyed, it is also important to review who will mediate it. In the same way as the formulation of the message is important, the sender should also be suitable for the target group. If the person who delivers the message lacks credibility with the target group, the message will not get the desired effect.

**Evaluation**

Monitoring the implementation process and evaluating the impact of the campaign may sometimes feel unnecessary. Often it is tempting to carry out a minimal follow-up or none at all when the budget for the campaign is limited. However, this is the worst option, especially from an economic perspective. Without an evaluation, nothing can be said about the impact of the campaign. The assessment should be done both before and after the campaign and not only measure the behaviours but also something called second rate factors such as attitudes and norms.

Because behaviour may be challenging to change, especially if the target audience does not see any problem with their behaviour, it can be satisfactory if the measure can get the target audience to start to reflect on their behaviours through this measure. The next step will be to perform additional campaign to take them further in the change process. For that reason, all work on behavioural change should be long term.

**5.6.3 Roles and responsibilities**

All actors have the opportunity to implement behavioural intervention actions individually or in collaboration within their respective areas of responsibility. An essential requirement for a successful campaign is close collaboration between campaign promoters (makers), researchers and decision makers.
6 Co-operation group composition

The following people have participated in the workgroup for this strategy:

The Swedish Transport Administration
Jörgen Persson (project leader), Johan Lindberg, Matteo Rizzi
Helena Stigson (Secretary)

Folksam

The Swedish Transport Agency (Transportstyrelsen)
Niclas Nilsson

The Swedish Police Authority
Ursula Eriksson

Swedish cycling
Klas Elm

Swedish national cycling advocacy organisation (Cykelfrämjandet)
Lars Strömogren

Moped & Motorcycle Industry Association (McRF)
Per Johansson, later replaced by Niklas Kristoffersson

Bicycle- Motor- and Sports Specialized Merchants (Cykel Motor och Sportfackhandlarna)
Berit Gibbs

Cycleurope Sweden Limited company
Claes Alstermark

Stockholm City
Joakim Boberg, Catarina Nilsson

Västerås City
Jenny Bergström

Uppsala
Tove Västibacken, Daniel Fritz

Eskilstuna
Petter Skarin

Linköping
Per-Erik Hahn, Melanie Larsson

Länsförsäkringar
Maria Wedin

The National Society for Road Safety (NTF)
Susanne Gustafsson

The Swedish National Association of Driver Trainers (STR)
Jimmy Ceihagen

Research Institutes of Sweden (RISE)
Viveca Wallqvist

SAFER
Tania Dukic Willstrand

Swedish National Road and Transport Research Institute (VTI)
Anna Niska, Jenny Eriksson

Trivector
Erik Stigell, Anna Clark

Chalmers Industrial Technology (CIT)
Anna Carlsson

The Swedish Consumer Agency (Konsumentverket)
Helena Nilsson/ Jonas Eriksson


European Parliament resolution on European road safety, September 2011, 2010/2235 (INI)


Hiselius, L; Svensson, Å; Bondemark, A; Rye, T (2014). To what extent can electric-bicycles (and electric-mopeds) replace today’s car traffic? Lund University Department of Technology and Society, 288. ISSN 16531930


Nilsson P, Stigson H, Ohlin M, Strandroth J. (2017). Modelling the effect on injuries and fatalities when changing the mode of transport from car to bicycle. Accident Analysis and Prevention, 100:30-36


Spolander and Young (2013). A market-based test for the development of safer bicycles - needs, opportunities and prerequisites.


Krister Spolander 2018, Pedestrian Association FOT. Accidents and risks resulting from increased walking and cycling traffic. Analysis of seasonal variations.


The Swedish Transport Administration, Analysis of Road Safety Trends 2017; management by objectives for road safety work towards the 2020 interim targets. Publication 2018: 143.


Road safety - Results from the Road Safety Survey 2017, Publication 2018: 140.


Increased cycling helmet usage. Cyclists’ driving forces and government control means. Magnus Andersson Evert Vedung Cajoma Consulting 2014.
Appendix 1

Measures assessed potential, source: The Swedish Transport Administration.

Measures’s potential to reduce fatalities and seriously injured on the bicycle.

Based on 120 fatalities in the period of 2008-2012 checked with 2013-2016 and 3800 seriously injured during the period of 2012-2013 checked with 2015-2016.

<table>
<thead>
<tr>
<th>Fatalities</th>
<th>Deviation from normal driving</th>
<th>Approaching critical situation</th>
<th>Critical situation</th>
<th>Unavoidable Crash</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operation and Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of loose gravel/leaves</td>
<td></td>
<td>5-10 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proper maintenance of dry-roads (pits/cracks)</td>
<td></td>
<td>5-10 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safe Use</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of bicycle helmets</td>
<td></td>
<td>10-15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Move to separated car-free bicycle lanes - urban area</td>
<td></td>
<td>5-10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Move to separated car-free bicycle lanes - not urbanized</td>
<td></td>
<td>15-20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe bicycle crossings</td>
<td></td>
<td>5-10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road lighting for visibility</td>
<td></td>
<td>0-5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjust the kerbstone (curbs)</td>
<td></td>
<td>0-5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safer bicycles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle lights and reflexes for visibility</td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safer motor vehicles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination of emergency brake and airbag in urban environment</td>
<td></td>
<td>max 30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trucks with warning system for cyclists at the blind spot</td>
<td></td>
<td>5-10%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Measure’s potential to reduce the number of killed cyclists. The measures are included in a so-called chain-of-events as described in the text.

<table>
<thead>
<tr>
<th>Seriously injured</th>
<th>Deviation from normal driving</th>
<th>Approaching critical situation</th>
<th>Critical situation</th>
<th>Unavoidable Crash</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operation and Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good de-icing (anti-icing)</td>
<td></td>
<td>15-20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of loose gravel</td>
<td></td>
<td>10-15 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proper maintenance of dry-roads (pits/track)</td>
<td></td>
<td>10 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safe Use</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of bicycle helmets</td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective jacket and pants</td>
<td></td>
<td>max 30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Move to separated car-free bicycle lanes</td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe bicycle crossings</td>
<td></td>
<td>5 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjust the kerbstone (curbs)</td>
<td></td>
<td>5-10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove stout objects</td>
<td></td>
<td>0-5 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safer tram tracks</td>
<td></td>
<td>0-5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road lighting for visibility</td>
<td></td>
<td>0-5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safer bicycles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter tires</td>
<td></td>
<td>15-20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABS brakes or the likes</td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stabilization or lower in step (safe boarding/ alighting)</td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle inspection (test)</td>
<td></td>
<td>5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle lights and reflexes for visibility</td>
<td></td>
<td>0-5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safer motor vehicles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination of emergency brake and airbag in urban environment</td>
<td></td>
<td>0-5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Measure’s potential to reduce the number of seriously injured cyclists. The measures are included in a so-called chain-of-events as described in the text.
## Measure's potential to reduce fatalities on the bicycle
Based on 19 fatalities in the period of 2012-2014 checked with 2015-2016.

<table>
<thead>
<tr>
<th>Action area/measure</th>
<th>Potential moped (%)</th>
<th>Number based on funds 2012-2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility/attention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visibility/attention towards other road users</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Other road user’s proper competence</td>
<td>8</td>
<td>&lt;1</td>
</tr>
<tr>
<td>MC driver/moped rider’s attention</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>Safer streets and roads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road environment’s visibility improvement</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>Median barriers</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Safer crossings (intersections) of urban areas</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Safer crossings (intersections) of high/country road</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>Safer side areas</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Motorcycle adapted middle- and side railings</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Clean, smooth and unbroken roadway</td>
<td>-</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Remedial measures on the road</td>
<td>-</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Class I moped on bicycle tracks (not urbanized)</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Safe use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed compliance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme behaviour</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>The motorcycle- and moped driver's proper competence</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>Properly used helmet</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Full protective clothing</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>No lending</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Medical requirements</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Safe group-driving</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rested driver</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Right driving license authorisation</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>Pillion</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>Safer vehicle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABS</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Theft protection</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Alco-locks/sobriety</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>E-call</td>
<td>-</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Traction control</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Air-bag</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Speed support system</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No technical shortcomings</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>Untrimmed mopeds</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>Other vehicle’s visibility improvements</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Registered vehicle’s only on their road</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>