

Analytic report

Review of interim Targets and Indicators for Road Safety in 2010–2020

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Foreword

This report presents an analysis and conclusions concerning interim targets and performance indicators for the road safety effort until 2020.

The report has been compiled by a project team at The Swedish Transport Administration on behalf of the Group for National Collaboration – Roads (GNS Road). The report is based primarily on analyses performed by a national team of analysts from the Swedish Transport Agency, Trafikanalys, the Swedish National Road and Transport Research Institute (VTI) and The Swedish Transport Administration.

The conclusions described in the report do not represent the official standpoints of the stakeholders involved but were drawn by their representatives on GNS Road based on the analysis.

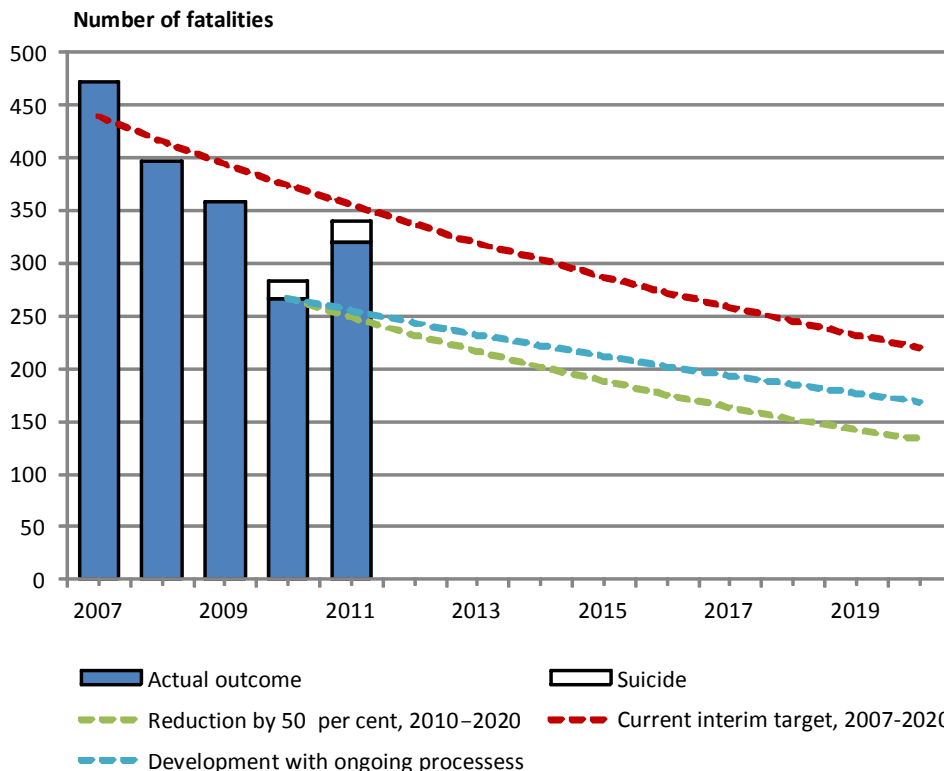
Summary

This purpose of this review is to provide decision data for a possible revision of the current interim targets and performance indicators. The idea is to ensure that the interim targets for road safety are both challenging and realistic, and that the best possible performance indicators are followed in terms of promoting effective management of the road safety effort.

The analysis is based on a brand new method that ensures more reliable results. The method proceeds from new findings about trends until 2020; data have been taken from Swedish Traffic Accident Data Acquisition System (STRADA) health care, The Swedish Transport Administration’s in-depth studies of fatal accidents and other sources. A new term has been added – very severe injury. A very severe injury is a personal injury that causes permanent medical impairment of health equivalent to a medical impairment of 10 per cent or more – Risk for Permanent medical impairment (RPMI) 10 per cent.

The analysis shows that current targets for the maximum number of fatalities in 2020 will be achieved only due to vehicle and infrastructure trends that can be prediction until 2020. The greatest improvement will be for protected road users. The analysis shows that it would be possible to strengthen the targets to a reduction of the number of fatalities by 50 per cent and very severe injuries (RPMI 10 %) by 40 per cent between 2010 and 2020. But that would require measures above and beyond those that are included in the prediction, corresponding to approximately 70 fewer fatalities and 210 fewer very severe injuries on an annual basis.

The diagram below shows alternative targets for trends in the number of fatalities in road traffic until 2020.



Below is a presentation of GNS Road’s view of the effort and the conclusions that it has drawn from the analysis. The conclusions do not represent the official standpoints of the stakeholders involved but were drawn by their representatives on GNS Road based on the analysis.

Reasons for performing an analysis

- The Government has previously stated that a more thoroughgoing review of the target structure should be conducted in 2012 and 2016.
- Current trends suggest that the target of no more than 220 fatalities in 2020 does not constitute a major challenge.
- The EU has adopted a target of a 50 per cent reduction in the number of fatalities between 2010 and 2020.
- Not all components of previous analytical methods and performance indicators are sufficient any longer.
- New measures have emerged that must be assigned targets, and new problems have appeared.
- Organisations are setting more ambitious targets.

Conclusions from the analysis

- The analysis, which presents conceivable trends from 2010 to 2020 with respect to the number of fatalities and very severe injuries (RPMI 10 %) in road crashes, is reliable and offers a solid basis for priorities in the ongoing road safety effort.
- Strengthening the targets in the manner suggested by the analysis is deemed to be realistic and sufficiently challenging to encourage a continuation of an effective effort and of innovative solutions in the area of road safety.
- According to the team of analysts, the set of performance indicators for the joint road safety effort should be revised.
- Trends in the area of safe vehicles and infrastructure will strongly contribute to target fulfilment for 2020. A number of challenges – particularly when it comes to improving compliance of speed limits, the safety of unprotected road users and the use of new technology – must also be dealt with.
- Achievement of the targets identified by the analysis requires efficient management by objectives and new knowledge, especially with respect to improving the safety of unprotected road users.

The national team of analysts proposes the following ten performance indicators for the road safety effort:

1. Compliance of speed limits, state-owned road network
2. Compliance of speed limits, municipal road network
3. Sober road users
4. Use of seat belts
5. Use of helmets
6. Safe cars in road traffic
7. Safe motorcycles in road traffic – anti-lock braking system (ABS)
8. Safe state-owned roads
9. Safe pedestrian, bicycle and moped (GCM) crossings in urban areas
10. Operation and maintenance of GCM paths

A number of the performance indicators are already being measured, while both measurements and measurement methods need to be developed for several of the performance indicators, including safe GCM¹ crossings in urban areas and operation and maintenance of GCM¹ paths. In order to round out the assessment of the current status of road traffic, additional measurements above and beyond the ten performance indicators are also being proposed.

¹ Abbreviation for pedestrian, bicycle and moped.

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1. Background

Mål för framtidens resor och transporter (Targets for Future Travel and Transport) (Government Bill 2008/09:93) states that the interim targets for road safety may be revised in the future, whereby the degree of target fulfilment, as well as changes in traffic and its composition, may be decisive to the deliberations.

The Government felt that a more thoroughgoing review of the target structure should be conducted in 2012 and 2016. This report presents a thoroughgoing review of interim targets and performance indicators.

1.1 Purpose of the review

The purpose of this review is to provide decision data for a possible revision of the current interim targets and performance indicators. The idea is to ensure that the interim targets for road safety are both challenging and realistic, and that the best possible performance indicators are followed in terms of promoting effective management of the road safety effort.

1.2 Delimitation

The analysis of interim targets and performance indicators that the national team of analysts has performed concerns trends with respect to the number of fatalities, severe injuries (RPMI 1 %) and very severe injuries (RPMI 10 %) due to traffic crashes until 2020, with 2010 as the base year. The analysis was supplemented by an analysis performed by the project team regarding slip and fall accidents in road traffic environments during 2010. Fatalities due to suicide were not included in the material studied for this report. Data about the number of fatalities and severe injuries, as well as the possible causes of the crashes, are based on material from STRADA health care and The Swedish Transport Administration's in-depth studies.

1.3 Performance of the review

The current interim targets and performance indicators were reviewed on behalf of GNS Road². GNS is a venue for sharing knowledge and for coordinating the efforts of various stakeholders in order to realise Vision Zero.

GNS Road meets six times a year; among the current issues under consideration are Management by Objectives of Road Safety and Review of Interim targets for 2020. GNS Road includes representatives of

- Swedish Work Environment Authority
- Folksam
- National Society for Road Safety
- Ministry of Enterprise, Energy and Communications
- National Police Board
- Swedish Association of Local Authorities and Regions

² Group for National Collaboration – Roads

- Toyota Sweden AB
- The Swedish Transport Administration
- Swedish Transport Agency

The report has been compiled by a project team at The Swedish Transport Administration. The report is based primarily on analyses performed by a national team of analysts from the Swedish Transport Agency, Trafikanalys, the Swedish National Road and Transport Research Institute (VTI) and The Swedish Transport Administration. Rune Elvik, an external consultant at the Institute of Transport Economics (TØI) in Norway, reviewed the effort.

The effort was conducted in dialogue with the businesses, stakeholders and public authorities that are part of the Towards Vision Zero - Together project. The dialogue included stakeholders in GNS Road at a total of five meetings, as well as additional stakeholders that were invited to two theme sessions and a workshop. Appendix 1 contains the list of participants at the workshop arranged on 10 February 2012.

The analysis and conclusions presented in the report will be submitted to and discussed at the results conference in Stockholm on 23 April 2012. Following possible revision of the report, the material will be presented to the Government.

2. Assumptions

Targets for Future Travel and Transport (Government Bill 2008/09:93) states that the starting point for choosing targets – as well as the years by which they are to be achieved – has been the EU's road safety target of a 50 per cent reduction in the number of fatalities during the 10 years up until 2010. The Government specified that Sweden's target should not be lower than the average among EU countries.

After the Government set the current interim targets, the EU established a new target of reducing the number of fatalities throughout the EU by 50 per cent for 2010-2020. The analysis examined whether it is possible for Sweden to adopt the new EU target.

2.1 Reasons for reviewing the current interim targets

There are a number of reasons for reviewing the current interim targets.

- The Government has previously stated that a more thoroughgoing review of the target structure should be conducted in 2012 and 2016.
- Current trends suggest that the target of no more than 220 fatalities in 2020 does not pose a major challenge.
- The EU has adopted the target of a 50 per cent reduction in the number of fatalities between 2010 and 2020.
- Not all components of previous analytical methods and performance indicators are sufficient any longer.
- New measures have emerged that must be assigned targets, and new problems have appeared.
- Organisations are setting more ambitious targets.

The background to this project is that the Government has stated that a more thoroughgoing review of the target structure should be conducted in 2012 and 2016. Furthermore, present road safety trends suggest that an analysis would be useful concerning whether the current target of no more than 220 fatalities in 2020 is sufficiently challenging.

The EU has adopted target of a 50 per cent reduction in the number of road traffic fatalities between 2010 and 2020. A September 2011 resolution of the European Parliament fully supports the target of reducing the number of road traffic fatalities by 50 per cent between 2010 and 2020. The Parliament calls for further clear and measurable targets to be set for the same period. In particular:

- a 60 % reduction in the number of children under the age of 14 killed in road accidents;
- a 50 % reduction in the number of pedestrians and cyclists killed in road collisions;
- a 40 % reduction in the number of people suffering critical injuries, on the basis of a uniform EU definition to be developed quickly.

Thus, the EU has set very high targets for its road safety effort. As one of the EU leaders when it comes to road safety, Sweden has good reason to review its options for maintaining the same high target-level as EU as a whole.

As indicated by the analysis below, a better method and better data are now available for analysing future road safety trends. The fact that new analyses of road safety trends are more reliable affects an assessment of the targets that can be regarded as reasonable.

New targets, particularly the one that concerns severe injuries, lead to fresh challenges and the need for updated measures. Thus, there are solid grounds for reviewing not only the targets but the performance indicators that are used to manage and monitor the road safety effort at the national level.

A number of stakeholders have set ambitious targets that are fuelling current trends. For example, Volvo has set a vision for 2020: “Our vision is to design cars that should not crash and by 2020 no one will be killed or injured in a Volvo”.

2.2 Current interim targets and performance indicators

Interim targets for 2007-2020

Targets for Future Travel and Transport (Government Bill 2008/09:93) sets the following interim targets for road safety.

Current interim targets

The goal for road safety should be specified in the form of the interim target that the number of fatalities is reduced by 50 per cent and the number of serious injuries by 25 per cent between 2007 and 2020. Measures to improve road safety for children should be given special priority.

The interim target will be achieved by means of a long-term, efficient and systematic road safety effort. That the key organisations become involved and cooperate in the effort is of decisive importance.

According to the Government, the road safety effort must be run in an efficient and target oriented manner. Furthermore, the road safety effort should give special consideration to the needs of groups such as children and the elderly who are particularly vulnerable in traffic.

To smooth out annual fluctuations, the Government decided to calculate the number of fatalities for the base year of 2007 as an average for 2006-2008. The Government stated that monitoring of the target should proceed from a similar calculation of an average. Fatalities totalled 445 in 2006, 471 in 2007 and 420 (according to preliminary figures at the time) in 2008. Thus, the target of a 50 per cent reduction would mean a decrease from approximately 440 to approximately 220 in 2020.

The bill defines to that which Vision Zero refers to as “severe injury” and sets a new target for serious personal injury. Severe injury is defined as follows.

Severe injury

A severe injury is a personal injury that causes permanent medical impairment of health equivalent to a medical impairment of 1 per cent or more (RPMI 1%).

Current performance indicators

The current performance indicators for road safety have been developed in a wide-ranging dialogue with the stakeholders in the road transport sector. Most of the performance indicators specify measurements, targets and road safety potential in the form a reduction in the number of fatalities. A report entitled *Målstyrning av trafiksäkerhetsarbetet – Management by Objectives for Road Safety Work* (Publication 2008:31) – issued by Vägverket estimated that the performance indicators suggested the potential for a total reduction of more than 250 in the number of fatalities by 2020.

Below are the performance indicators that are used in current management by objectives, including the targets for each performance indicator until 2020, as well as the estimated potential for reducing the number of fatalities.

Performance indicator	Target for 2020	Road safety potential, fatalities
Compliance of speed limits, state-owned road network	80 %	88
Compliance of speed limits, municipal road network	80 %	29
Sober road users	99.90 %	30
Use of seat belts	99 %	40
Use of helmets (bicyclists)	70 %	10
Safe vehicles	100 %	90
Safe heavy vehicles	100 %	25
Safe state-owned roads	75 %	50 (62)
Safe GCM ³ crossings	-	15
Safe intersections	-	15
Safe and satisfactory rescue	-	
Rested drivers	6 %	
High valuation of road safety	80	

Figure 2.1. Current indicators, including goals and road safety potential

³ Abbreviation for pedestrian, bicycle and moped.

2.3 Previous opinions

Following the Government's decision concerning the current interim targets, the joint Towards Vision Zero - Together project has been managed and monitored on the basis of the 13 performance indicators to which the stakeholders have agreed. The results have been presented and discussed at annual conferences since 2009. In preparation for each results conference, the national team of analysts has performed an Analysis of Road Safety Trends for the previous year.

An international expert panel has previously reviewed the joint effort. Both the panel and the national team of experts have had opinions about the performance indicators used in management by objectives. A number of the current performance indicators may be called into question given that they do not fully meet the criteria to which they should be subject. Section 5.2 offers a detailed discussion of the performance indicators that have been called into question for one reason or another.

2.4 Other current projects

A number of current projects touch upon this review in various ways.

Bicycling investigation and bicycle strategy with action plan

The Government appointed a commission (Directive 2010:93) in September 2010 to review the regulations that affect the conditions to which bicyclists are subject. The purpose was to make bicycling simpler, more attractive and safer. The commission is to examine the traffic regulations that affect bicyclists, as well as provisions that govern planning and design of the in road in road traffic environment. The investigator is also to review the regulations and other conditions that affect bicycle parking and the ability to take bicycles on trains and buses. If the investigator deems it relevant, the assignment can also include an examination of other regulations and conditions that are important in this connection. The assignment has obtained an extension and is to be presented by 31 October 2012.

In collaboration with the Swedish Transport Agency, The Swedish Transport Administration presented a strategy and action plan on 1 December 2011 for increased, safe bicycling. The strategy proposes that the primary focus be on a systematic collaborative effort between the state and the 50 largest municipalities and on strengthening the status of bicycling in community development. According to the strategy, it is also important to analyse and improve the correlations between safety measures and their effects in order to make it safer to bicycle. The strategy proposes new approaches – such as collaboration between insurance companies, county councils, municipalities and other stakeholders – to increase helmet use.

Evaluation of new speed limits

The Riksdag (Government Bill 2006/07:73, Official Report 2006/07: TU15, Official Written Communication 2006/07:175) decided in 2007 that new speed limits should be adopted such that decision making authorities would be able to use ten steps in the range of 30-120 kilometres per hour. The Government has tasked The Swedish Transport Administration with evaluating the impact of the new speed limits on transport policy targets. The Swedish Transport Administration is to consider the possibility of taking measures to improve the results. As part of the effort, The Swedish Transport Administration is collaborating with the Swedish Transport Agency, the Swedish Association of Local Authorities and Regions and

other stakeholders to analyse the need of eventually removing some of the current speed limits. The evaluation will be presented to the Government no later than 1 June 2012.

National action plan for the safety of the elderly

At the request of the Government, the National Board of Health and Welfare submitted a proposal in December 2011 for a national action plan to promote the safety of the elderly. Among the matters that the report discusses is the effort to prevent slip and fall accidents and traffic crashes among the elderly. A new target was proposed for slip and fall accidents but none for traffic crashes beyond the interim targets that had already been adopted. In collaboration with the National Police Board, The Swedish Transport Administration, the Swedish Association of Local Authorities and Regions and other authorities and stakeholders, the National Board of Health and Welfare has put together a proposed action plan.

Joint management framework for operation and maintenance of roads and railways

The Government tasked The Swedish Transport Administration in February 2012 with developing and implementing a joint management framework for operation and maintenance of roads and railways. The assignment includes a description of the ways that various operation and maintenance measures impact the transport system, means of prioritising various measures and approaches to ensuring improved, upgraded reporting. An interim report is to be submitted on 1 June 2012. The final report is due on 31 December 2012.

Management by objectives and safety performance indicators in the area of rail transport

The Swedish Transport Administration has launched a project in the area of rail transport that corresponds to this review.

Joint strategy to improve safety for motorcyclists and mopedists

A review of the current motorcycle and moped strategy is currently under way; stakeholders concerned are examining issues such as anti-lock braking systems (ABS), speed limits, technical flaws, helmets, safe roads and streets, and extreme behaviour. A new version of the strategy is scheduled for completion at the end of June 2012.

3. Performance of the analysis

The analysis is based on a brand new method that ensures more reliable results. The method proceeds from new findings about trends until 2020; data have been taken from STRADA⁴ health care, The Swedish Transport Administration's in-depth studies of fatal crashes and other sources. A new term has been added – very severe injury.

3.1 Premise of the analysis

The premise of the analysis of interim targets and performance indicators is to examine whether strengthening the target of no more than 220 fatalities to no more than 133 fatalities in 2020 is reasonable. The premise reflects the adoption by the EU of an overall target to reduce the number of road traffic fatalities by 50 per cent from 2010 to 2020. The EU has also specified that the number of life-threatening injuries is to decline by 40 per cent during the same period. The analysis also takes that target into consideration by examining the prospects for reducing the number of very severe injuries (RPMI 10 %) by 40 per cent between 2010 and 2020.

The analysis describes the conditions and parameters that are most important to impact and the potential for doing so. Based on these assumptions, an assessment is performed to determine the targets that are reasonable for 2020 with respect to reducing the number of both fatalities and severe injuries.

3.2 Method previously used

Management by objectives of the road safety effort and monitoring performance indicators as a means of promoting achievement of the targets have been under way since 2007. The current targets were developed by identifying the conditions (such as compliance of speed limits and the percentage of safe vehicles) that were deemed to have a clear correlation with the number of road traffic fatalities. The conditions came to be called performance indicators.

A correlation was established between each road safety performance indicator and the reduction in fatalities that would occur if the performance indicator were to change. Because the correlations were general, they were not linked to the actual fatal crashes that had occurred in the Swedish road network. The result was a list of performance indicators with parallel correlations between safety measures and their effects. See Figure 3.1 on the next page.

Each effect was calculated on the assumption that all other conditions in the transport system remained the same. In reality, however, the various performance indicators interact with each other. In other words, the calculations of the various effects were inaccurate given that a particular accident can reflect changes to more than one performance indicator.

The method prevented adding up the potential of the various performance indicators to reduce the number of fatalities as a means of estimating the total impact generated by changes to each one of them. To correct for the double counting, the estimated total effect was multiplied by a factor of 0.6 on the belief that the problem had thereby been fully addressed. The product of the sum of the individual effects and the double counting factor of 0.6

⁴ Swedish Traffic Accident Data Acquisition System.

generated a figure that formed the basis of the target that was regarded as reasonable for 2020 compared with 2007.

Condition	Measurement	Status, 2007	Target, 2020	Effect on road safety
Compliance of speed limits, state-owned road network	Percentage of traffic volume within the speed limit	43 %	80 %	88
Compliance of speed limits, municipal road network	Increased percentage of traffic volume within the speed limit		86 %	29
Sober road users	Percentage of traffic volume with sober road users (under 0.2 permillage)	99.76 %	99.90 %	30
Use of seat belts	Percentage of seat-belted drivers and passengers in cars	96 %	99 %	40
Use of helmets	Percentage of bicyclists with helmets	25 %	70 %	10
Safe cars	Number of new cars with the highest safety rating according to the European New Car Assessment Programme (Euro NCAP) – including new technology that integrates active and passive safety	60 %	100 %	90
Safe heavy vehicles	Percentage of new heavy vehicles with automatic emergency brake systems	0 %	100 %	25
Safe state-owned roads	Percentage of traffic volume on roads with speed limits above 80 kilometres per hour that are divided	52 %	75 %	50

Figure 3.1. Initial indicators with goals and assumed correlations between safety measures and effects in 2007

3.3 New system-wide method

Studying the chain of events for actual crashes

The method used this time to generate a suitable target for reducing the number of fatalities is based on actual traffic crashes that occurred in Sweden during the course of 2010. Each

accident that resulted in a fatality was analysed on the basis of a chain of events that ranged from “normal” driving to collision. Below are examples of chains of events for motorists and bicyclists.

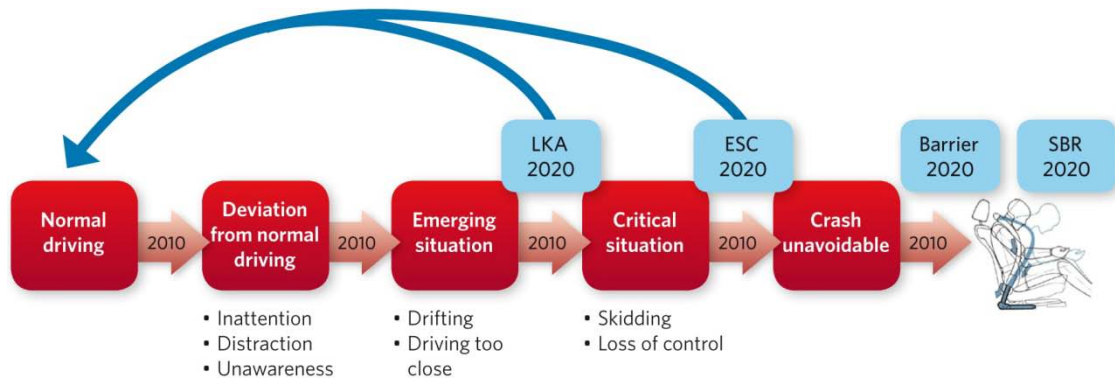


Figure 3.2 Chain of events leading to a crash. Adapted from Rizzi et al. (2009)

A chain of events that leads to a fatal accident can be broken at a number of different links. Studying crashes in this manner permits management of the risk for double counting the effects and allows more detailed projections for 2020.

The data for the analysis were taken from The Swedish Transport Administration’s in-depth studies of fatal crashes as matched with official statistics for 2010. The method of analysing very severe injuries proceeds from a similar premise under other conditions, as described in greater detail below.

Two-step analysis: prediction and analysis of additional measures

The analysis is performed in two steps.

- First, a prediction is made concerning the percentage of fatalities and very severe injuries (RPMI 10 %) that will be counteracted by likely vehicle and infrastructure technology trends until 2020. The assumptions concerning vehicle and infrastructure technology trends are cautious.
- An analysis is then performed concerning the potential of measures and areas of intervention based on additional requirements to achieve the targets under study – a reduction of 50 per cent in the number of fatalities and 40 per cent in the number of very severe injuries (RPMI 10 %) by 2020.

A key difference compared to the situation when the current interim targets were set is that more accurate information is available about the safety technology with which vehicles will be equipped in 2020. Infrastructure trends can also be more accurately projected. Based on the data generated by the in-depth studies, each fatal accident in 2010 can be examined to determine whether it would have occurred or been fatal under conditions projected for 2020.

A fatality that can be avoided as the result of a change to a particular condition (for example, the 2020 vehicle might be equipped with an anti-skid system) is then removed from the analysis such that it does not affect the examination of the potential of the next change to a condition. Thus, the theoretical calculation cannot prevent a fatality more than once.

Examining all conceivable conditions in 2020 and applying them one by one to the various crashes that occurred in 2010 generates a total effect for all conditions without double counting.

This approach makes it easier for the road safety effort to concentrate on the crashes that are not being eliminated by ongoing vehicle and infrastructure technology trends and that therefore require additional attention.

Handling severe injuries

Severe injuries are analysed with the same approach as fatalities but the conditions are different. Because the projected number of severe injuries is based on the probability of medical impairment, no data are available that permit identification of individuals with such injuries. People must be analysed instead based on the probability that they will sustain severe injuries.

Calculations were performed for each person who was entered in STRADA health care as injured in 2010 to determine the probability that they would develop a medical impairment of at least 1 per cent and at least 10 per cent. Information from STRADA health care were supplemented by data from STRADA police about vehicles and the chain of events leading to collision. An upward adjustment factor was then applied to compensate for the fact that not all emergency rooms reported to STRADA in 2010.

Thus, each individual who was entered as injured in STRADA for 2010 was assigned a risk of developing a 1 per cent and 10 per cent medical impairment. Subsequently applying the vehicle and infrastructure technology projected for 2020 to each traffic injury in 2010 (according to the same method as the analysis of fatalities) permits an analysis of the probability that the same accident would lead to medical impairment of 1 per cent and 10 per cent. The reduction of the Risks for Permanent Medical Impairment (RPMI) projected between 2010 and 2020 are then added up, generating a combined prediction of the total reduction in the number of severe injuries for 2020 based on the anticipated measures, as well as the number of injuries that still need to be prevented (the “residual”) in order to achieve the targets.

3.4 New term – very severe injury (RPMI 10 %)

Severe injury (RPMI 1 %) is currently defined as that which leads to medical impairment of at least 1 per cent. The definition was adopted on the basis of the ethical approach inherent to Vision Zero to the effect that no traffic injury that has lifelong consequences should be accepted.

However, an interim target of reducing the number of injuries that lead to medical impairment of 1 per cent and upwards poses several problems. The biggest problem is that the definition includes so many different kinds of injuries and severities that it is difficult to prioritise the most effective measures.

An unstable wrist joint is one example of an injury that entails 7 per cent medical impairment. Impaired mobility of the shoulder entails medical impairment of 5-20 per cent and whiplash of 5-15 per cent. Figure 3.3 below shows the distribution of traffic injuries among bicyclists with respect to various parts of the body depending on the assumed percentage of medical impairment. If the emphasis is on reducing the number of injuries that entail medical impairment of 10 per cent or more, the focus shifts more clearly towards head injuries.

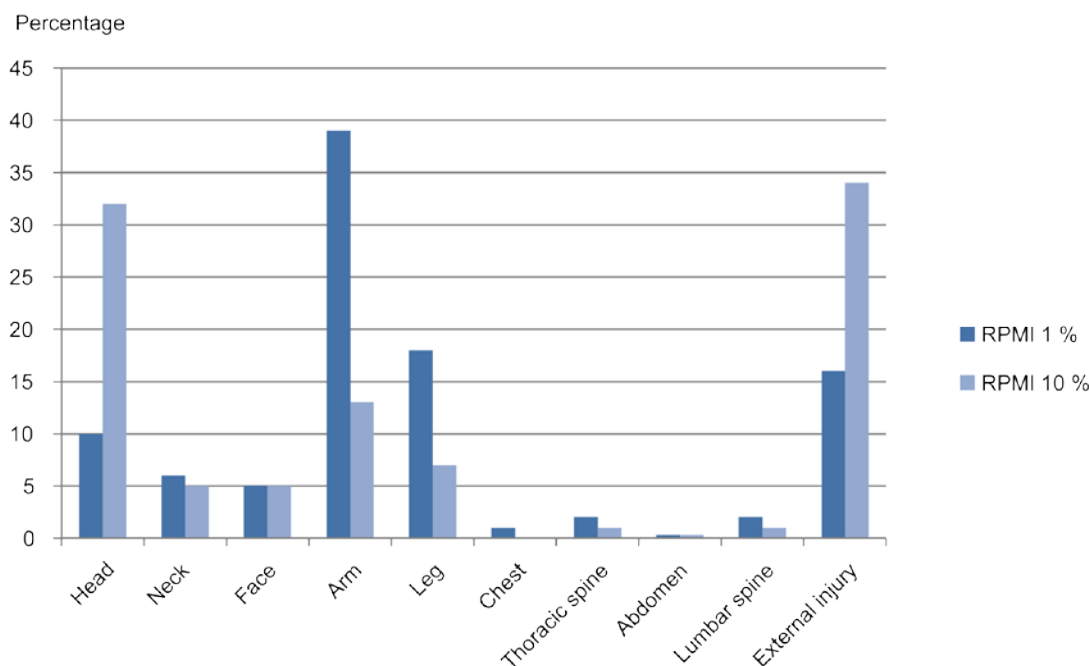


Figure 3.3. Distribution of very serious injuries among bicyclists based on 1 per cent and 10 per cent medical impairment. Source: Folksam.

Another problem with monitoring RPMI 1 per cent is that the loss of data is much greater than for those with RPMI 10 per cent. Because injuries that entail a lower probability of medical impairment are not perceived to be as serious, they do not come to the attention of emergency medical care as often. Injuries with RPMI 10 per cent or more will subsequently be referred to as very severe injuries (RPMI 10 %).

Very severe injury

A very severe injury is a personal injury that causes permanent medical impairment of health equivalent to a medical impairment of 10 per cent or more (RPMI 10%).

Thus, a target that focuses primarily on reducing very severe injuries is clearly suitable. Even if a new target for very severe injuries is adopted, however, it may be appropriate to retain the current target for severe injuries. The focus of the road safety effort will presumably be on severe injuries, but systematic monitoring of both targets will thereby be assured.

Shifting the emphasis towards very severe injuries does not change the focus with respect to the means of transport. The reason is that the distribution of injuries by means of transport is the same regardless of whether RPMI 1 per cent or 10 per cent is monitored.

3.5 Assumptions and delimitations

The approach to carrying out the analyses required certain assumptions. One of the key assumptions is that no decline of vehicle, infrastructure or driver capacity standards will occur before 2020. The analysis assumes improvements only, i.e., that current standards will not decline.

Important to point out is that this analysis does not take a statistical approach but operates on the micro level. The analysis assumes that the presented conditions have a 100 per cent

effect on the crashes and fatalities to which the effect is applied. Such conclusions can be drawn because in-depth knowledge is available about each particular accident.

Example 1

Median barriers generally reduce the number of fatal accidents by approximately 80 per cent. The detailed information about every fatal accident to which this study has access, however, permits identification of the types of accidents that are prevented by a median barrier (i.e., are among the 80 per cent) and those that are not (i.e., are not among the 80 per cent). The effect of the median barrier is assumed to be 100 per cent for fatal accidents that are assumed to have been prevented.

Example 2

A general model would estimate the effect of seat belt use by multiplying the total number of fatalities among unbelted passengers by 0.5, given that the general effect of seat belt use is to reduce the risk of fatality by 50 per cent. The model in this analysis, however, calculates the effect of seat belt use by applying the assessments in the coroner's report concerning each fatality among unbelted passengers. The number of passengers who could have survived according to the coroner also represents the total effect of seat belt use among the population considered by the analysis.

An important delimitation for the analysis is to study only the potential for reducing the number of fatalities and severe injuries due to traffic crashes. A road traffic accident is defined as an event that occurs on a road or street, involves at least one moving vehicle and causes personal injury or property damage. Due to the delimitation, this analysis excluded slip and fall accidents in road traffic environments and suicide in traffic.

The analysis also excluded post-crash measures (rescue, care and rehabilitation). The reason is that the analysts had limited knowledge of such measures, and that this type of detailed analysis has difficulty capturing healthcare improvements. The assumption that standards will not decline was applied to post-crash conditions as well. In other words, we assumed that rescue, care and rehabilitation would retain the same standards throughout the period until 2020. One result of this delimitation is that the project did not examine the effect of e-Call. Nevertheless, the team of analysts concluded that the introduction of e-Call through legislation, etc., would reduce the number of fatalities by no more than 2-3 until 2020. In other words, the inclusion of this particular effect would not significantly change the figures and predictions provided by the analysis.

Finally, it should be pointed out that the initial analysis – which examined each individual accident – did not consider expansion of traffic volume, demographic changes or random factors (there were very few traffic fatalities in 2020, no doubt partially due to chance). These factors will be considered later on when a reasonable target for 2020 is to be recommended. Nevertheless, it appears even at this point that the low fatality figures were not distributed in any unusual way between various groups of road users, types of crashes, etc. This suggests that the various means of transport will not need to be weighted when the low fatality figures for 2010 are considered.

4. Analysis of target level

The analysis shows that current targets for the number of fatalities in 2020 will be achieved only due to prediction vehicle and infrastructure technology trends. The analysis demonstrates that the targets for fatalities and very severe injuries (RPMI 10 %) can be strengthened and identifies the key areas of intervention for achieving them.

4.1 Prediction for 2020 – projection of conditions

A total of 266 road traffic fatalities occurred in 2010, and 724 people are estimated to have sustained very severe injuries (RPMI 10 %). Based on the parameters in the matrix below, assumptions have been made concerning the number of these fatalities and very severe injuries that will be eliminated by 2020 by virtue of more sophisticated cars and infrastructure expansion. The approach to assessing vehicle safety has been consistently conservative. If new vehicles of a particular type are equipped with a safety system as of a particular year, the calculation assumes that no vehicle had that model before.

		Parameter	Prediction
VEHICLE	Heavy vehicles	Lane keeping assist system (LKAS)	100 % in new vehicles as of 2015
		Automatic brakes for frontal collisions	100 % in new vehicles as of 2015
		Anti-skid systems	100 % in new vehicles as of 2015
		Seat belt reminder systems	100 % in new vehicles as of 2011
	Cars	Lane keeping assist system (LKAS)	100 % in new vehicles as of 2015
		Anti-skid systems	100 % in new vehicles as of 2008
		Automatic brakes for pedestrians + pedestrian protection, 21 p	100 % in new vehicles as of 2015
		Automatic brakes for bicyclists	100 % in new vehicles as of 2015
		Automatic brakes for frontal collisions	100 % in new vehicles as of 2015
		Seat belt reminder systems, front seat	100 % in new vehicles as of 2009
		Seat belt reminder systems, back seat	100 % in new vehicles as of 2015
		Collision safety	10 years, new cars
	Whiplash protection	40 % in new vehicles as of 2000, 60 % in new vehicles as of 2000, 80 % in new vehicles as of 2010	
Motor-cycles	Anti-lock brake systems	50 % in new vehicles as of 2010, 100 % in new vehicles as of 2017,	
ROADS	State-owned	Median dividers	Roads with speed limit of 90 kilometres/hour, > 4,000 vehicles per day and wider than 12 metres
	Municipal	Intersections	50 % of intersections in urban areas with functional road classification of 3-5 become roundabouts
		GCM ⁵ crossings with speed bumps	20 % of GCM ¹ crossings in urban areas with functional road classification 3-5 have speed bumps

Figure 4.1 Assumptions by the prediction for vehicle and infrastructure trends.

⁵ Abbreviation for pedestrian, bicycle and moped.

The various parameters have different effects depending on the order in which they are applied to various chains of events leading to collision. Thus, some conditions may ostensibly affect crashes to only a small extent because they have already been included as part of another change to a condition (such as sober road users vs. seat belt use). As a result, only the total reduction in number of fatalities and severe injuries is reported. Analysts will expand their knowledge of how the effects interact with each other.

A total of 266 road traffic fatalities occurred in 2010, and 724 people are estimated to have sustained very severe injuries. Applying the new method to these crashes reduces the total number to 167 and 606 respectively. Thus, a total of 266 of the fatalities are deemed to be affected by the conditions presented in Figure 4.1 above, i.e., they will no longer occur in 2020. The corresponding number for very severe injuries is 118. Figure 4.2 below illustrates the percentage of the road safety problem that remains (the residual) after measures have been taken in accordance with the prediction.

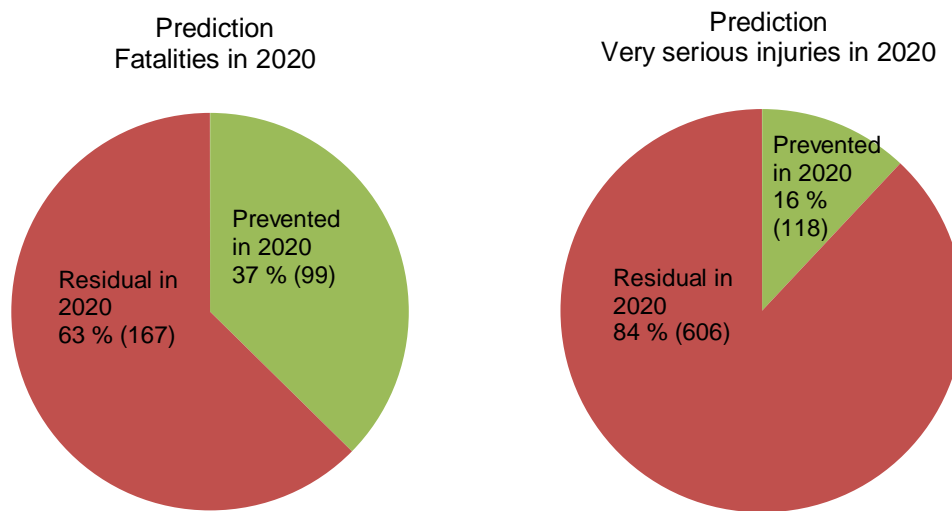


Figure 4.2. Prediction for the number of fatalities (167) and very serious injuries (606) in 2020 after projection of vehicle and infrastructure technology trends.

It should be emphasised that the combined predictions of 99 fewer fatalities and 118 fewer very severe injuries until 2020 are based on cautious assumptions. In the first place, the effects of the various safety systems are considered only as of the year that they are assumed to become standard in all new vehicles. The safety benefits achieved during the years when the systems are available but not standard in all new vehicles are not included. In the second place, many crashes are prevented by more than one of the above parameters – for example, a severe injury can be prevented both because the car is equipped with a seat belt reminder system and because the road is divided. Even if not all the predictions described in Figure 4.1 above are realised, it is fully possible that crashes and injuries can be prevented in another manner.

Figure 4.3 shows a possible distribution of the prediction reduction in the number of fatal crashes by means of transport after the 99 cases have been removed.

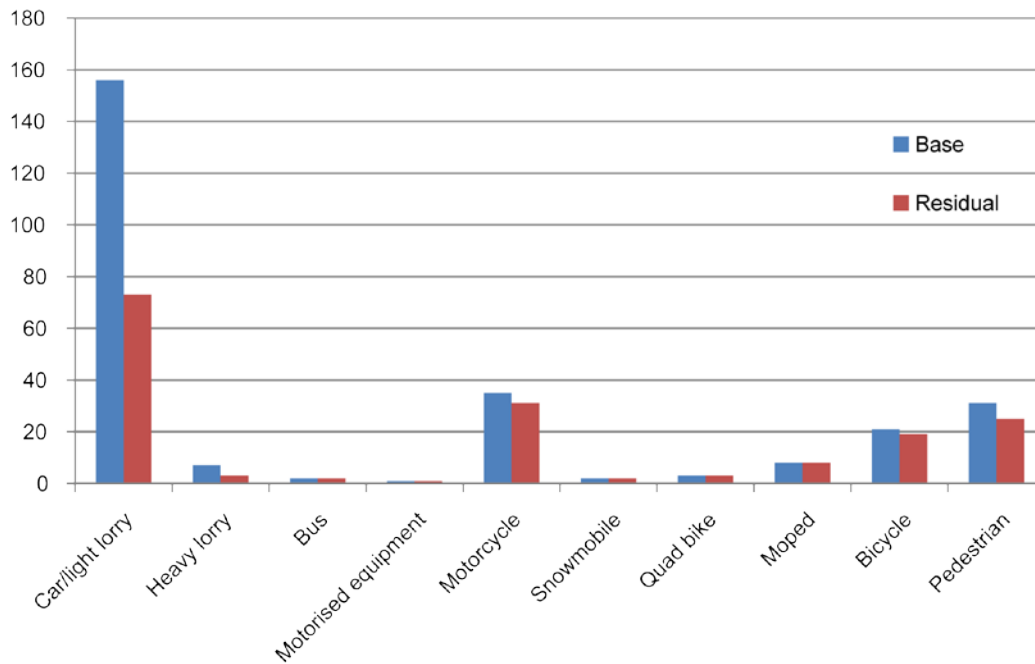


Figure 4.3. Prediction for 2020 by means of transport based on projection of vehicle and infrastructure technology trends. Source: In-depth studies of fatal accidents.

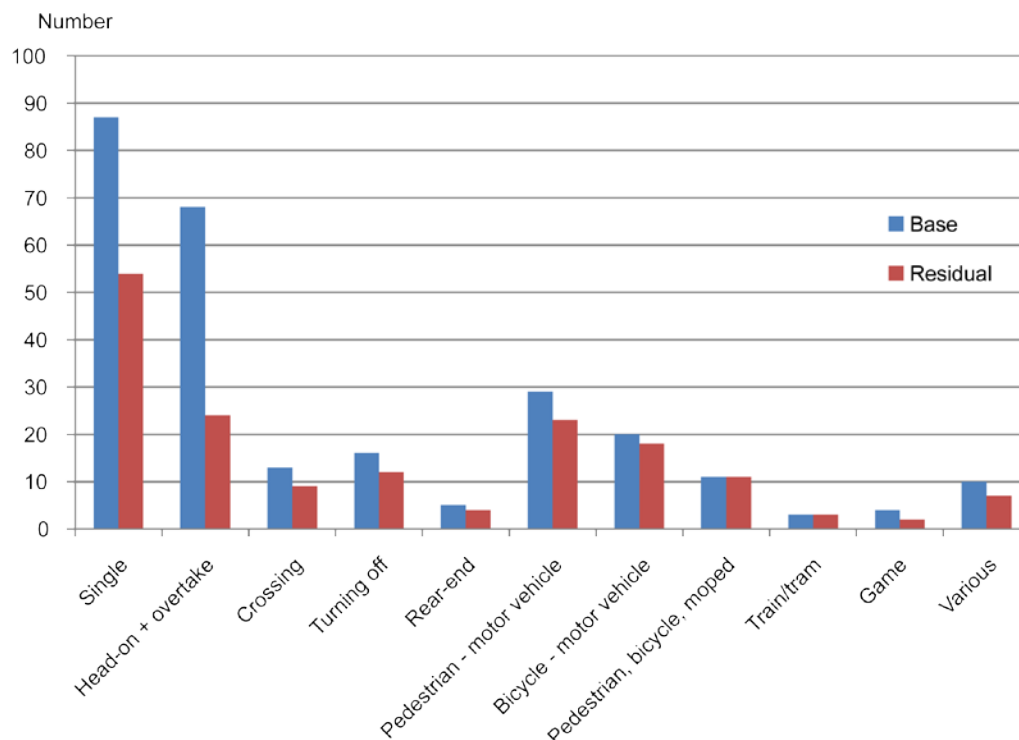


Figure 4.4. Prediction for fatalities in 2020 by type of accident based on projection of vehicle and infrastructure technology trends. Source: In-depth studies of fatal accidents.

Figure 4.4 above shows the distribution of the prediction reduction in the number of fatalities by type of accident. Figure 4.5 below shows a possible distribution of the prediction reduction in the number of very severe injuries by means of transport after the 118 cases have been removed. The reduction is greatest for cars and least for unprotected road users.

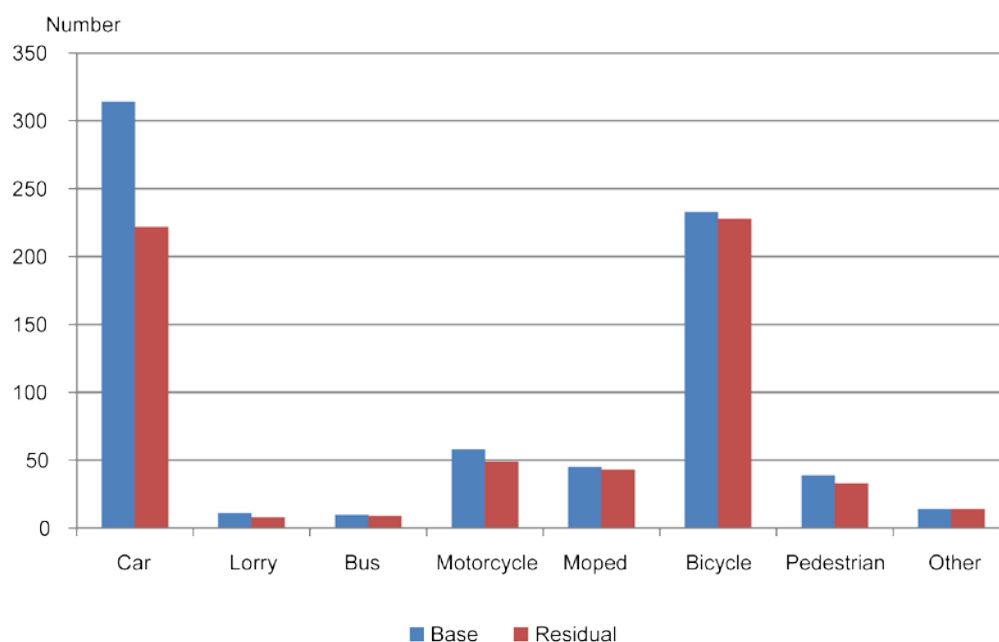


Figure 4.5. Prediction for very serious injuries in 2020 by means of transport (RPMI 10 per cent) based on projection of vehicle and infrastructure technology trends. Source: STRADA (Swedish Traffic Accident Data Acquisition System).

Thus, arriving at an assessment of what constitutes reasonable targets proceeds from the total number of traffic fatalities and very severe injuries in 2010, eliminating the events that are prediction to have been prevented by 2020. An attempt then begins to reduce the number of fatalities and very severe injuries by means of additional measures until 2020 – an approach that may be regarded as possible under certain conditions. They are presented below as areas of intervention/measures (see Section 4.3).

An elementary sensitivity analysis of the prediction has been performed. A calculation has been performed to determine how the prediction would be affected if 50 per cent rather than 100 per cent of new cars were equipped with safety systems in 2015. The result would be a reduction of approximately 91 fatalities instead of 99 as a result of these safety systems. Similarly the reduction would be 36 fewer (544 instead of 580) for the number of severe injuries and 6 fewer for the number of very severe injuries (112 instead of 118).

The sensitivity analysis demonstrates that the difference would not be particularly great. The reason is that the additional automatic brakes systems, which the prediction assumes will be installed in all new cars as of 2015, will have the greatest impact on the number of fatalities and injuries after 2020. The safety system that will have the greatest single impact on road safety is implementation of lane keeping assist systems. The reason is that swerving into the next lane is associated with a large percentage of crashes that lead to either death or very severe injury.

4.2 Prediction of trends until 2030

Many of the projections in the prediction (see Figure 4.1 above) can be made for years after 2020 as well. Figure 4.6 below supplements Figure 4.3 with a corresponding prediction for 2030. However, it is important to point out that the longer the prediction horizon, the greater the uncertainty. Nevertheless, the example illustrates the types of crashes that can be avoided due to processes that will be under way in 2020 but will not have had time yet to make an impact.

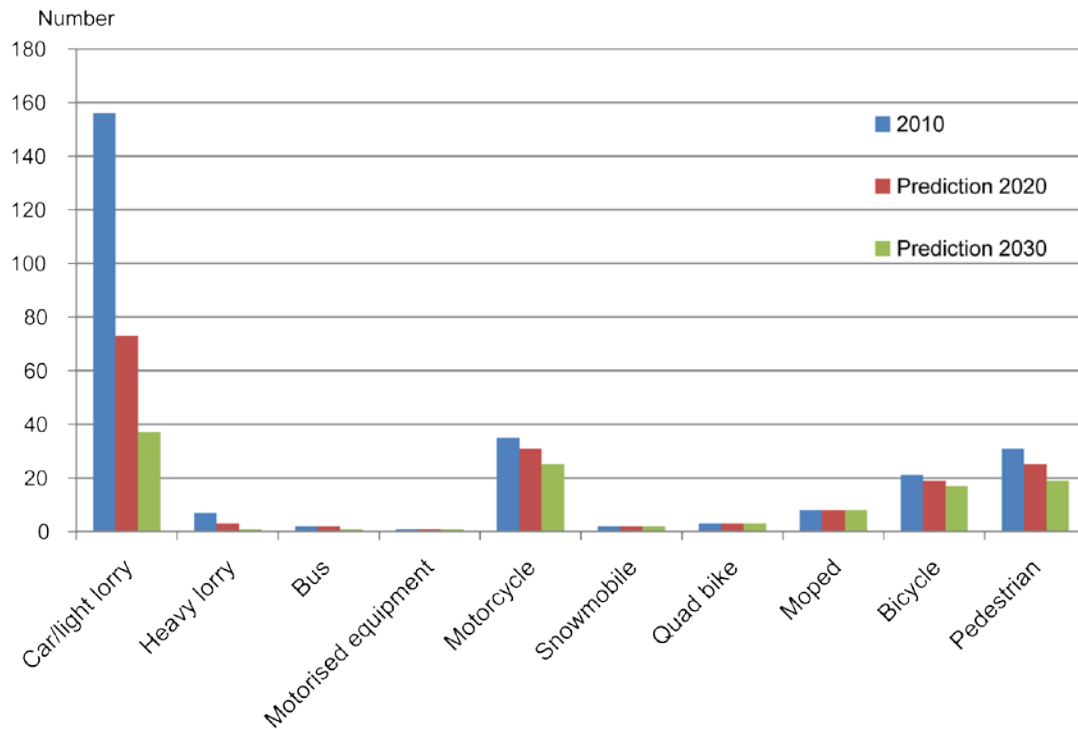


Figure 4.6. Prediction for 2020 by means of transport based on projection vehicles and infrastructure technology trends. Source: In-depth studies of fatal accidents..

4.3 Additional measures for achieving new targets by 2020

Measures and interventions above and beyond those that have been predicted will affect the number of fatalities and injuries in 2020. However, such measures are not foreseeable in the same manner as those described in the prediction. Figure 4.7 below presents the potential for a reduction in the number of fatalities and very severe injuries (RPMI 10 %) for each individual measure and area of intervention. Thus, the table presents the potential offered by specific measures, as well as and conditions in traffic that may result from a number of different measures. Generally speaking, the potential of a change to a condition is greater than of a specific measure.

Area of intervention/measure	Potential, fatalities in 2020	Potential, severe injuries (RPMI 1 %) in 2020	Potential, very severe injuries (RPMI 10 %) in 2020
Speed limit reduction, municipal roads, 3 %	3	153	21
Speed limit reduction, municipal roads, 5 %	5	253	35
Speed limit reduction, municipal roads, 8 %	8	399	55
Speed limit reduction, state-owned roads, 3 %	11	153	26
Speed limit reduction, state-owned roads, 5 %	18	249	42
Speed limit reduction, state-owned roads, 8 %	27	383	64
Replacement of all vehicles, alternative 1	8	49	11
Replacement of all vehicles, alternative 2	17	60	13
100 % New motorcycles equipped with ABS, 2015	1	17	3
Divided roads with lower circulation	3	0	0
Better guard rail protection when the speed limit is 80 kilometres per hour or higher	3	34	8
GCM ⁶ crossings with speed bumps, 50 % of those with functional road classification 3-5	x	9	3
GCM ¹ crossings with speed bumps, 80 % of those with functional road classification 3-5	x	18	5
GCM ¹ crossings with speed bumps, total	3	45	11
Breath alcohol ignition interlock device programme	0	x	x
Unguarded level crossings secured	2	4	2
Reconstruction, turn-offs and backing up	6	7	4
Use of seat belts	14	96	38
Safe intersections, state-owned road network	18	193	28
Safe intersections, municipal road network	1	141	26
Increased percentage of sober road users	31		31
Proper helmet use, motorcyclists		7	8
Proper helmet use, mopedists	1	9	5
Proper helmet use, bicyclists	6	16	29
Tuned moped	2	x	x
Fatigue	11	x	x
Distraction/visibility	59	x	x
Extreme behaviour	27	x	x
Driving licence/illegal driving	15	x	x

⁶ Abbreviation for pedestrian, bicycle and moped.

Summer road maintenance of GCM ¹ paths	x	140	18
Winteroperation of GCM ¹ paths	x	90	7
Construction of municipal GCM ¹ paths	5	x	20
Construction of state-owned GCM ¹ paths	10	x	10
Measures, single-bicycle crashes	4	x	150
Operation and maintenance, state-owned road network	2	x	x

Figure 4.7. Potential for fewer fatalities and injuries per individual measure or area of intervention. The potential refers to measures above and beyond those considered in the prediction. Each potential has been developed on the basis of the goals of reducing the number of fatalities by 50 per cent, serious injuries by 25 per cent and very serious injuries by 40 per cent. X means that the potential cannot be quantified based on current knowledge. The various potentials cannot be added up without adjusting for double counting.

The above table demonstrates that the correlation between the reduction in the number of fatalities and very severe injuries (RPMI 10 %) is greater than the correlation between fatalities and severe injuries (RPMI 1 %). Note that the various potentials have been calculated separately and cannot be added up without taking the fact that the effects overlap into consideration.

4.4 Adjustment of targets to expansion of traffic volume, demographics and unexplained variation

To determine whether a target of 133 fatalities in 2020 is reasonable while establishing a reasonable target for very severe injuries (RPMI 10 %), a number of external factors must be taken into consideration. Expansion of traffic volume and demographic trends are two facts that will affect whether or not the targets are achieved. Random fluctuations in the number of fatalities and very severe injuries (RPMI 10 %) should be factored in as well.

In line with the prevailing prediction model, annual expansion of traffic volume is assumed to be 1 per cent. Furthermore, demographic trends until 2020 will presumably have both a favourable and unfavourable impact on road safety. The fact that people are living longer generally increases the number in the transport system, most likely leading to more traffic injuries. But the members of the generation currently on the verge of retirement have driven all their lives and are likely to continue doing so to a greater extent than their parents and grandparents. Thus, they may be better protected than previous generations of elderly road users. Young people are waiting longer to get their driving licences, another boon for road safety. As a result, an overall assessment indicates that the calculations should not be adjusted for demographic changes until 2020.

The number of fatalities and injuries in road traffic is subject to random fluctuations. Fatalities were very low in 2010, presumably more so than the actual risk level would suggest. Three-year averages of fatalities and very severe injuries in 2009-2011 are used to compensate for random fluctuations. According to the average, there should have been 307 fatalities and 721 very severe injuries in 2010. The difference between the average and the actual outcome for 2010 is then multiplied by just under 40 per cent, the figure assumed to be missing with the prediction for 2020. Thus, allowance must be made for an additional reduction of 24 (the difference between 307 and 24 multiplied by 0.6) in the number of fatalities to correct for the random decline in 2010.

Figures 4.8 and 4.9 below show the reduction in the number of fatalities and very severe injuries that the road safety effort should make allowance for above and beyond the prediction.

Status quo, 2010	266
Eliminated by 2020 according to the prediction	- 99
Residual in 2020 after the prediction	167
Expansion of traffic volume, 1 % per year	+ 11
Demographic effects	+/-0
Corrected for 3-year average	+ 24
Residual in 2020 after consideration of external factors	202
Half of number of fatalities in 2010 remain in 2020	-133
Remaining to be eliminated above and beyond the prediction	69

Figure 4.8. Calculation of reduction in number of fatalities on an annual basis above and beyond the prediction in order to achieve the goal of no more than 133 fatalities in 2020.

Status quo, 2010	724
Eliminated by 2020 according to the prediction	- 118
Residual in 2020 after the prediction	606
Expansion of traffic volume, 1 % per year	+ 41
Demographic effects	+/- 0
Corrected for 3-year average	- 3
Residual in 2020 after consideration of external factors	644
60 % of very severe injuries (RPMI 10 %) in 2010 remain in 2020	- 434
Remaining to be eliminated above and beyond the prediction	210

Figure 4.9. Calculation of reduction in the number of very severe injuries (RPMI 10 %) on an annual basis above and beyond the prediction in order to achieve the target of a 40 per cent decrease by 2020.

The conclusion is that measures are needed to reduce the number of fatalities by an additional 69 in order to achieve the target of no more than 133 in 2020. See Figure 4.8 above. Similarly, the number of very severe injuries (RPMI 10 %) must be reduced by 210 to achieve a 40 per cent decrease. See Figure 4.9 above.

In addition to the consideration that has been paid to expansion of traffic volume, demographics and correction for the 3-year average, the phenomenon of random fluctuations in accident statistics deserves examination. The number of fatalities in a particular year has a random component. Figure 4.10 below illustrates the statistical confidence interval for the target of a risk level corresponding to 133 fatalities in 2020 (95 per cent statistical significance).

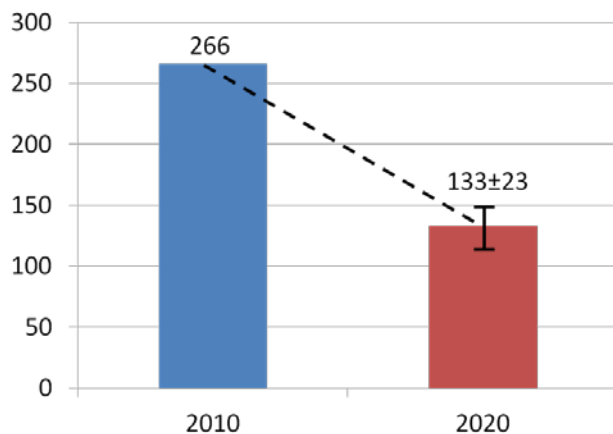


Figure 4.10. The statistical confidence interval for the goal of a risk level corresponding to 133 fatalities in 2020 with 95 per cent significance.

The diagram demonstrates that there will not necessarily be exactly 133 fatalities in 2020 just because that particular risk level is achieved. However, it can be predicted with 95 per cent certainty that there will be 110-156 fatalities in 2020. Thus, it is reasonable to set a target of no more than 133 fatalities – the midpoint of that range.

4.5 Possible scenario for reduction in fatalities and very severe injuries above and beyond predictions.

Two alternative targets have been analysed when it comes to reduction in the number of very severe injuries (RPMI 10 %). The lower target of 25 per cent represents the same percentage reduction as that which currently applies to severe injuries (RPMI 1 %) in 2007-2010. The higher target corresponds to the proposal of the European Parliament that the number of life-threatening injuries be reduced by 40 per cent. Attempting to reduce very severe injuries (RPMI 10 %) by 25 per cent would essentially be less ambitious than the present target. A 40 per cent reduction in the number of very severe injuries (RPMI 10 %) would correspond more closely to the current target for a 25 per cent reduction in the number of severe injuries (RPMI 1 %). Thus, only the analysis of a 40 per cent reduction in the number of very severe injuries (RPMI 10 %) is presented below.

Figure 4.11 below presents the scenarios (combinations of measures and interventions) corresponding to the reduction in the number of fatalities and very severe injuries required to achieve the proposed targets. Double counting has been taken into consideration.

The numbers in the table represent the reduction in the number of fatalities or very severe injuries above and beyond the prediction that is required to achieve the targets. The targets specified for various measures and areas of intervention are not always based on calculations of reasonableness but rather on that which is required to achieve the targets whether or not known or effective solutions are currently available.

Area of intervention/measure	Potential Fatalities in 2020	Potential, very severe injuries (RPMI 10 %) in 2020	50 % reduction in number of fatalities	40 % reduction in number of very severe injuries (RPMI 10 %)
Speed limit reduction, municipal roads, 3 %	3	21		
Municipal speed limit reduction, 5 %	5	35	5	35
Municipal speed limit reduction, 8 %	8	55		
Speed limit reduction, state-owned roads, 3 %	11	26		
Speed limit reduction, state-owned roads, 5 %	18	42	22	51
Speed limit reduction, state-owned roads, 8 %	27	64		
Replacement of all vehicles, alternative 1	8	11	6	8
Replacement of all vehicles, alternative 2	17	13		
100 % New motorcycles equipped with ABS, 2015	1	3	1	3
Divided roads with lower circulation	3	0		
Better guard rail protection when the speed limit is 80 kilometres per hour or higher	3	8		
GCM ⁷ crossings with speed bumps, 50 % of those with functional road classification 3-5		3		
GCM ⁷ crossings with speed bumps, 80 % of those with functional road classification 3-5		5		
GCM ⁷ crossings with speed bumps, total	3	11	2	8
Breath alcohol ignition interlock device programme	0	x		
Unguarded level crossings secured	2	2	0	
Reconstruction, turn-offs and backing up	6	4	3	2
Use of seat belts	14	38	4	18
Safe intersections, state-owned road network	18	28	0	0
Safe intersections, municipal road network	1	26		10
Increased percentage of sober road users	31	31	9	9
Proper helmet use, motorcyclists		8	0	0
Proper helmet use, mopedists	1	5	1	3
Proper helmet use, bicyclists	6	29	3	14
Tuned moped	2	x	1	1
Fatigue	11	x	2	6
Distraction/visibility	59	x	3	9
Extreme behaviour	27	x	0	0
Driving licence/illegal driving	15		5	
Summer road maintenance of GCM ⁷ paths		18		10
Winteroperation of GCM ⁷ paths		7		4
Construction of municipal GCM ⁷ paths	5	20		6

⁷ Abbreviation for pedestrian, bicycle and moped.

Construction of state-owned GCM ¹ paths	10	10	1	3
Measures, single-bicycle crashes	4	150		10
Operation and maintenance, state-owned road network	2	x	1	
			69	210

Figure 4.11. Possible scenario for reduction of deaths and very serious injuries above and beyond predictions. A goal is proposed for each measure or area of intervention that is deemed necessary to achieve the new interim targets under analysis. X means that the potential cannot be quantified based on current knowledge. Since double counting has been taken into consideration, the goals in the right-hand fields may be added up.

What do the proposed targets mean?

The targets presented in Figure 4.11 above correspond to an additional reduction in the number of fatalities by 69 and the number of very severe injuries by 210 for 2020 above and beyond the prediction. Those reductions require more ambitious interventions and measures, including lower speed limits and means of ensuring that fewer bicyclists are injured.

The focus of the scenario is based on indications that have been received from many stakeholders with regard to the importance of reducing fatalities and very severe injuries among unprotected road users. Because the prediction for 2010-2020 consists largely of measures that emphasise the safety of protected road users, measures that benefit unprotected road users should be prioritised. Thus, the target of the scenario presented in Figure 4.11 above is to reduce the number of fatalities and very severe injuries among unprotected road users as much as possible. Proposed measures and areas of intervention concerning GCM⁸ crossings with speed bumps, proper use of moped helmets, winter and summer road maintenance of GCM¹ paths and single-bicycle crashes, reflect that target.

The analysis shows that single-bicycle crashes account for a significant percentage of very severe injuries among bicyclists. Only a handful of measures have yet been implemented in this area. It would be unfortunate if the lack of such measures prevented the interim target effort for 2020 from including this large category of crashes. The above table presents a category of unspecified “measures, single-bicycle crashes” to emphasise the potential of reducing such injuries. Achievement of the target of a 40 per cent reduction in the number of very severe injuries requires fewer single-bicycle crashes. However, no specific measures are being proposed. Thus, management by objectives must promote new measures if the more ambitious target is to be achieved.

An ambitious target is proposed with respect to lowering the average speed. Lower speed limits and improved compliance can achieve this target. The following estimates have been made as examples of that which is required to accomplish the various reductions in average speed:

- If everyone obeys the speed limit, average speed will decrease by approximately 8 per cent
- If the speed limit for all roads with a speed limit of 90 kilometres per hour is reduced to 80 kilometres per hour, the average speed will decrease by approximately 1 per cent.

⁸ Abbreviation for pedestrian, bicycle and moped.

- If the speed limit for all roads with a speed limit of 90 kilometres per hour is reduced to 80 kilometres per hour and generally by 3 per cent, the average speed will decrease by approximately 4 per cent.
- If the speed limit for all roads with a speed limit of 90 kilometres per hour is reduced to 80 kilometres per hour and automatic speed cameras are installed, the average speed will decrease by just over 2 per cent.
- If the speed limit for all roads with a speed limit of 90 kilometres per hour is reduced to 80 kilometres per hour and by 3 per cent generally, and automatic speed cameras are used, the average speed will decrease by just over 5 per cent.

The greatest potential for reducing the number of fatalities and very severe injuries is currently on roads with speed limits of 90 kilometres per hour. Such roads comprise approximately 10,000 kilometres and account for approximately 70 fatalities every year. Below are a few projections of the annual impact of various combinations of speed limit reductions and median dividers.

- If all roads with speed limits of 90 kilometres per hour are divided, the number of fatalities will decrease by approximately 55.
- If all roads with speed limits of 90 kilometres per hour are divided, the number of fatalities will decrease by approximately 15.
- If the speed limit for all roads with a speed limit of 90 kilometres per hour is reduced to 80 kilometres per hour and equipped with automatic speed cameras, the number of fatalities will decrease by approximately 40.
- If all roads with a speed limit of 90 kilometres an hour and circulation of more than 4,000 vehicles per day (2,000 kilometres) are divided, the number of fatalities will decrease by approximately 25; if only roads wider than 12 metres (750 kilometres) are included, the number of fatalities will decrease by approximately 10.
- If all roads with a speed limit of 90 kilometres per hour and circulation of more than 4,000 vehicles a day (2,000 kilometres) are divided and the speed limit for the remaining roads with a speed limit of 90 kilometres per hour is reduced to 80 kilometres per hour and equipped with automatic speed cameras, the number of fatalities will decrease by approximately 55; if only roads wider than 12 metres (750 kilometres) are included , the number of fatalities will decrease by approximately 10.

4.6 Impact assessment for target fulfilment, 2020

Assuming that a new target of no more than 133 fatalities in 2020 is achieved, a rough estimate can be made concerning the types of road users who will benefit most. Due to the approach taken, the potential inherent to the various categories of measures has been applied randomly rather than directly to particular individuals. Thus, an estimate of the distribution of the number of fatalities among various age categories in 2020 is particularly uncertain. The assumptions concerning reduction of the risk of very severe injuries (RPMI 10 %) among particular individuals as the result of future areas of intervention are also highly uncertain. Thus, an impact assessment in terms of age, gender, etc., is not feasible. Only predictions that take safer vehicles and infrastructure into consideration have enabled more reliable categorisation.

The final assessments concern other impact of significance for other transport policy targets, as well as the costs associated with carrying out certain key measures.

Impact on various categories of fatalities

Figure 4.12 below shows how achieving the target of reducing the number of fatalities by 50 per cent would be distributed among various means of transport, age groups and types of crashes.

A satisfactory prediction with respect to safer vehicles and infrastructure construction by 2020 can already be made. Effective interventions for reducing the number of unprotected road users are not as easy to survey or implement. Based on available projections, the mix of performance indicators suggests a reduction in the number of passenger fatalities by 65 per cent and in the number of unprotected road user fatalities by 40 per cent. The projected reduction in the number of fatalities among pedestrians and bicyclists by 35 per cent is insufficient to achieve the target that the European Parliament is proposing for 2020.

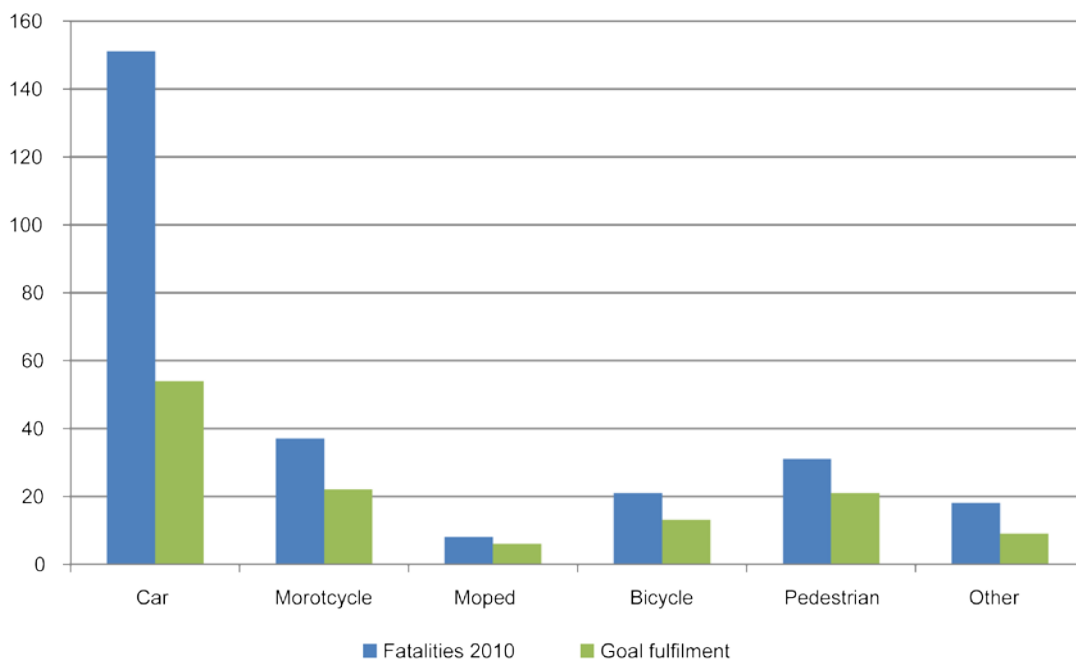


Figure 4.12. Fatalities broken down by means of transport before (266) and after goal fulfilment. Source: In-depth studies of fatal accidents.

The analysis suggests that the reduction in the number of fatalities would be greatest among young and middle-aged road users, with the exception of 15-17 year-olds. The reduction in the number of fatalities for 14-year-olds and younger is projected at 60 per cent, in line with the target proposed by the European Parliament for 2020. See Figure 4.13 below.

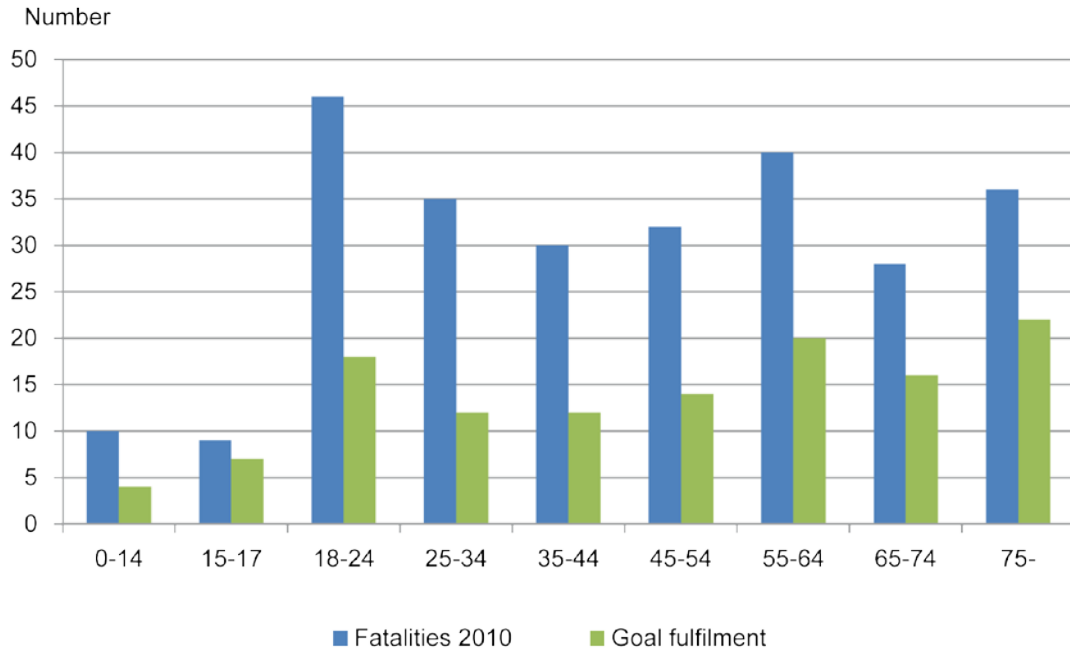


Figure 4.13. Fatalities broken down by age before (266) and after goal fulfilment.
Source: In-depth studies of fatal accidents.

Safer cars with a larger percentage of active systems, as well as ongoing construction of median dividers, are projected to reduce the number of single-vehicle crashes and collisions by approximately 65 per cent once all measures have been considered. See Figure 4.14 below.

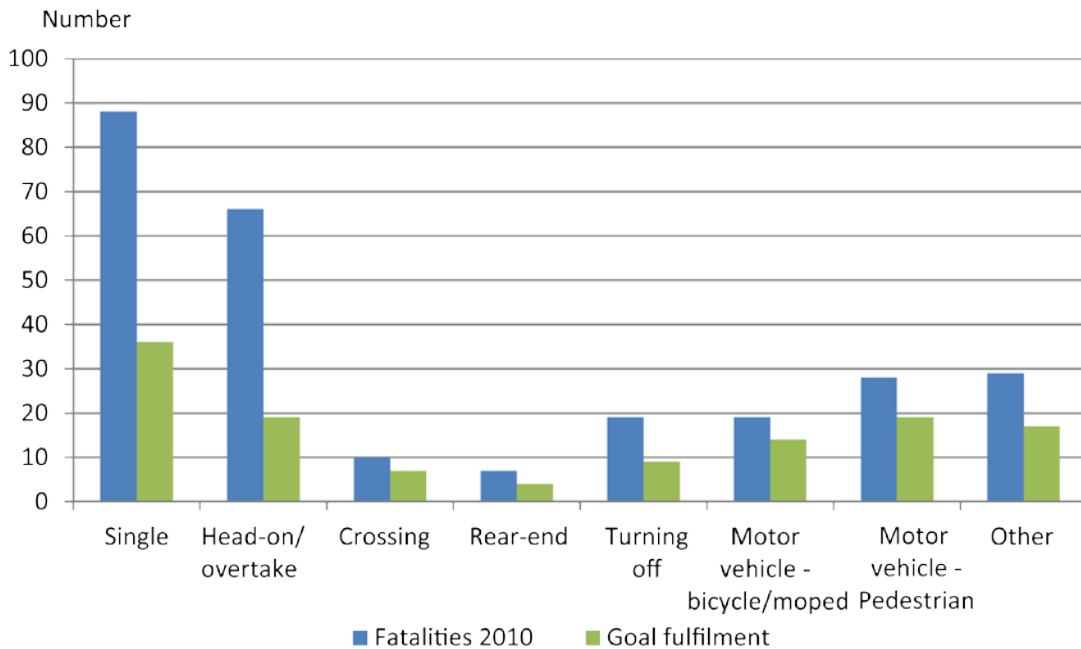


Figure 4.14. Fatalities broken down by type of accident before (266) and after goal fulfilment.
Source: In-depth studies of fatal accidents.

Impact on very severe injuries

It has not been possible to project the breakdown of target fulfilment among various means of transport, age groups and types of accident for very severe injuries in the same way as for fatalities. Motorists and bicyclists are the primary categories for which the number of very severe injuries needs to be reduced if the target of 40 per cent is to be achieved.

An assessment of road safety benefits in economic terms

The socio-economic valuation based on the number of deaths and injuries in 2010 amounts to approximately SEK 55 billion. The material costs of damage and injuries caused by traffic accidents make up around SEK 15 billion per year. This sum mainly includes costs for property damage, costs for production loss due to sick leave or premature death, healthcare costs and administrative costs. The remainder, approximately SEK 40 billion, consists of “risk assessments” (human health value).

Reducing the number of deaths by half, which would correspond to 133 lives, is valued at approximately SEK 3 billion. There are currently no socio-economic cost estimates as regards people who are injured according to the definition of ‘very severe injuries’ in traffic. If the number of ‘seriously injured’ (admitted to a hospital for inpatient care) is assumed to decrease at the same rate as during the most recent 10-year period, then the number of severe injuries would decrease by 25 per cent by the year 2020, which would be valued at approximately SEK 8 billion. The reduction in deaths and severe injuries would amount to a combined value of SEK 11 billion.

Impact on other transport policy targets

The target for the performance indicator of compliance of speed limits in the state-owned road network by 2020 is 80 per cent by 2020, corresponding to a 4 kilometre per hour reduction in average speed.

Given that better compliance of, as well as lower, speed limits reduce fuel consumption, the impact on achievement of the climate target is generally positive. A decrease in average speed from 110 to 90 kilometres per hour reduces carbon dioxide emissions, fuel consumption and energy use by 10-20 per cent, as well as nitrogen oxide emissions by 20-40 per cent and hydrocarbon emissions by approximately 20 per cent. Lower speeds also affect traffic noise. A decrease of 10 kilometres per hour in the range of 30-60 kilometres per hour reduces traffic noise by 2-4 dB(A). The differences are so pronounced that better compliance of speed limits on roads with speed limits of 50, 70 and 90 kilometres per hour would have a major impact on traffic noise in adjacent residential and recreational areas.

According to a previous estimate, a decrease in average speed by 10 kilometres per hour on state-owned roads with speed limits of 70 kilometres per hour or more (excluding sparsely populated areas) would reduce carbon dioxide emissions by 700,000–1,000,000 tonnes. Given that emissions from road traffic total 19 million tonnes, the change would be 4-5 per cent. A decrease in the average speed on state-owned roads by 4 kilometres per hour would reduce carbon dioxide emissions by an estimated 2-3 per cent.

Reduced speeds in the road transport system involve less accessibility for car traffic. Lower speeds in urban areas, however, provide greater safety and accessibility for unprotected road users within and across the road and street network. The fact that women are generally more favourable to speed reductions than men is worth noting given that the target of a gender-

neutral transport system requires ascribing the same weight to the values of women and men with respect to traffic and infrastructure.

The greater investment in operation and maintenance to improve bicycle safety as proposed by the analysis would increase accessibility for bicyclists. The impact on health and the environment would be salutary as well. Better operation and maintenance for bicyclists, perhaps the most important measure for combating slip and fall accidents in road traffic environments as well, would also benefit pedestrians. In other words, significant synergies can be attained by improving operation and maintenance of walkways and bicycle paths.

Impact on investments in infrastructure and vehicles

The target for the performance indicator of a safe state-owned road network is that divided roads, which accounted for 67 per cent of traffic volume on roads with speed limits above 80 kilometres per hour in 2010, will account for 100 per cent of traffic volume on roads with speed limits above 80 kilometres per hour in 2020. More than 10,000 kilometres of roads with a speed limit of 90 kilometres per hour are currently undivided. To achieve the target for the performance indicator, either the roads must be divided or the speed limit reduced. Important functional links can be raised to 100 kilometres per hour in connection with median divider or guard rails, whereas other roads should be lowered to 80 kilometres per hour. Most of the roads involved are regional, i.e., subject to county plans.

It has not been feasible to estimate municipal costs. Costs arise in connection with ensuring safe intersections for car traffic and safe GCM¹ links on and across streets with the same or higher speed limit, as well as physical measures intended to make the streets more self-explanatory at lower speed limits.

For the performance indicator of safe vehicles, the target is that 80 per cent of cars in traffic have the highest safety rating according to the European New Car Assessment Programme (Euro NCAP). The costs for developing safe vehicles are allocated through a process controlled by the market.

4.7 Summary of the analysis

The analysis provides a basis for revising and strengthening the interim targets of the Swedish road safety effort for 2020. The analysis also identifies what the new targets would require in terms of measures and interventions.

The analysis of a new interim target for reducing road traffic fatalities is based on the following:

- Road traffic fatalities totalled 266 in 2010.
- The analysis projects a total of 167 fatalities for 2020 given the vehicle and infrastructure technology improvements already under way.
- A total of 69 fatalities need to be prevented through additional measures in order for the target of no more than 133 in 2020 to be regarded as reasonable. Consideration has been taken to expected expansion of traffic volume and the fact that there were relatively few fatalities in 2010.

The analysis of a new interim target for reducing very severe injuries is based on the following:

- A total of 724 very serious road traffic injuries occurred in 2010.
- The analysis projects a total of 606 very severe injuries for 2020 given the vehicle and infrastructure technology improvements already under way.
- A total of 210 very severe injuries need to be prevented through additional measures in order for the target of a 40 per cent reduction by 2020 to be regarded as reasonable. Consideration has been taken to expected expansion of traffic volume and the fact that there were relatively few fatalities in 2010.

5. Analysis of road safety performance indicators

The current performance indicators for safety in the area of road transport need to be modified in order to more effectively improve the management and monitoring of the road safety effort. A total of 10 performance indicators and additional measurements are proposed to support management by objectives for the 2020 targets.

5.1 Management of objectives through performance indicators

Performance indicators are quantifiable measurements of road traffic conditions that are important to influence in order to reduce the number of fatalities and very severe injuries. The performance indicators are used to manage and monitor the road safety effort. The performance indicators are measured each year and presented at a results conference.

Due to updated information and targets, as well as a greater focus on new areas of intervention (some of which are new), the current set of performance indicators needs to be reviewed. Moreover, certain additional conditions need to be monitored to verify that the assumptions of the analysis are still valid.

New requirements for performance indicators

The following requirements are proposed for the performance indicators to be monitored as part of the Towards Vision Zero - Together road safety effort.

Requirements that an road safety indicator should meet

1. The indicator should have a satisfactory level of validity. Known correlations must exist between the trends of the indicator and the number of fatalities and/or serious injuries.
2. The indicator must be reliable. It must be amenable to quantification and monitoring in the same way every year. That the indicator is reliable and measured in a consistent manner is more important than that it be fully representative for the entire country.
3. The indicator must be easy to quantify such that the process is not too extensive, resource consuming or complicated.
4. Unless special circumstances dictate otherwise, the indicators should remain the same from year to year in order to monitor them on an ongoing basis.

5.2 Performance indicators under revision

Summary of the recommendations of the team of analysts

Some of the current performance indicators can be challenged given the above requirements. Figure 5.1 below summarises the recommendations of the team of analysts for the Performance indicators under revision.

Performance indicators under revision	Recommendation of the team of analysts
Compliance of speed limits, municipal road network	Improve measurement methods immediately
Safe heavy vehicles	Create a measurement that follows sales of the safest heavy vehicles on the market
Safe GCM ⁹ crossings	Improve measurement methods immediately
Safe intersections	Improve measurement methods immediately
Safe and satisfactory rescue	Look for correlations between safety measures and their effects as part of ongoing analysis
Rested drivers	Look for correlations between safety measures and their effects as part of ongoing analysis
High valuation of road safety	Create a valuation index based on the proper performance indicators and monitor it annually

Figure 5.1. Indicators under revision and recommendations of the team of analysts.

Compliance of speed limits in the municipal road network.

No systematic speed measurements are currently being performed in the municipal road network. As a result, no measurement follows the performance indicator of “Increased percentage of traffic volume within the speed limit on municipal roads” to determine whether trends are heading in the right direction. The comments of the international experts about the performance indicator point out that very flaw (see below).

International expert panel, 2009 report:

“Whether there are speed data for any of the municipal roads should be studied. The expert panel assumes that at least some of the larger municipalities are obtaining speed data. These data should be collected and summarised in an index that may be regarded as representative of speed trends on municipal roads.”

International expert panel, 2010 report:

“There are no speed data for municipal roads, but the changes observed for national roads will be assumed to apply to all public roads.”

Recommendation of the team of analysts:

Regardless of the measurement methodology used in the future and the source of funding for monitoring, the team of analysts recommends that The Swedish Transport Administration appoint a coordinator to collect and analyse data, as well as perform an annual assessment of the trend of the performance indicator. The team of analysts recommends that an effort to develop a method of systematically measuring speeds in urban areas be launched immediately.

Safe heavy vehicles

The performance indicator “percentage of new heavy vehicles with automatic emergency brake systems” was challenged due to neither the lack of a correlation between safety measures and their effects or the ability to quantify and monitor its trends (although the international expert panel was somewhat sceptical about the clarity of the statistical calculations on which the calculation of the effects was based). The criticism focused on the

⁹ Abbreviation for pedestrian, bicycle and moped.

fact that the performance indicator is related to technology that is not yet available on the market and may not be available in time to impact outcomes for 2020.

International expert panel, 2010 report:

“There was no progress with respect to automatic emergency brakes on heavy vehicles in either 2008 or 2009. Unless some progress is expected to start soon, the expert panel recommends dropping this safety performance indicator and developing a new safety performance indicator to monitor the safety of heavy vehicles. Moreover, the statistical relationship of the current performance indicator to the number of fatalities has not been clarified”.

Because the performance indicator will have target fulfilment of 0 per cent for the next few years, it cannot serve its purpose of encouraging relevant stakeholders to take measures.

Recommendation of the team of analysts:

An approach similar to the performance indicator of “safe cars” is proposed. The safe cars performance indicator is monitored by following the percentage of new cars that have the highest safety rating according to Euro NCAP. The performance indicator improves due not to any technical support systems that it specifies but to the fact that the safest cars on the market sell best and are in greatest demand.

Similarly, an performance indicator for heavy vehicles could be constructed on the basis of the safest heavy vehicles that the current market has to offer. That which is regarded as safest would be modified and included in the performance indicator, which would then contain additional safety enhancing systems, as new systems are launched. One likely consequence of such an approach is that the effect of the performance indicator would be estimated as somewhat lower.

The team of analysts recommends holding off on fully establishing how the performance indicator should be worded until an analysis of the interaction and systemic effects of the various performance indicators has been completed.

Safe GCM¹⁰ crossings and safe intersections

The international expert panel finds that these two performance indicators have not been properly measured yet and that doing so is a somewhat demanding process. The team of analysts agrees that these performance indicators should be challenged due to the lack of data available for analysis.

Recommendation of the team of analysts:

The team of analysts recommends that an effort to develop a method of systematically measuring these performance indicators in urban areas be launched immediately. The effort would benefit from synchronisation with the development of speed data collection in urban areas; the involvement of the Swedish Association of Local Authorities and Regions and/or individual municipalities would be valuable.

Safe and satisfactory rescue

Based on data from SOS Alarm, the international expert panel (2010) concluded that the current measurement of the promptness with which rescue services arrive is satisfactory. However, the analysis of the results of the measurement is deficient. The international team

¹⁰ Abbreviation for pedestrian, bicycle and moped.

of experts concludes that a correlation between the promptness of rescue operations and the risk of fatality or injury in road traffic can probably be established but that it has not happened yet. Given that no correlation has been established, data are lacking to specify a reasonable target for the performance indicator.

The international expert panel has nothing to say about the fact that the current performance indicator does not measure or analyse care and rehabilitation interventions although the original proposal hoped that it would do so. However, the team of analysts regards that flaw as a basis for challenging or improving the performance indicator.

Recommendation of the team of analysts:

The team of analysts recommends an ongoing effort primarily aimed at assessing the effect of rehabilitation on very severe injuries. Experts in traffic medicine should be brought in, perhaps at an extra workshop. The results of the effort will permit an informed discussion about a reasonable target.

Rested drivers

The international expert panel has summarised arguments that challenge this performance indicator and has concluded that it should be eliminated. The arguments are summarised below:

The panel does not believe that self-reporting provides reliable information. A driver may fail to report fatigue, or exaggerate the problem due to media publicity, etc.

The correlation between the performance indicator and the number of crashes remains unknown. While there are no grounds for questioning that fatigue increases the risk of crashes and many research studies have identified a correlation, the team of experts does not believe that self-reporting of episodes of fatigue reflect true sleepiness or fatigue.

With the exception of rumble strips in the centre of the road, few physical measures are available to reduce the occurrence of driving while tired. Preventing tired drivers from getting behind the wheel in the first place is more important than waking them up with rumble strips in the road.

Why has a decision been made to study fatigue in particular when mobile telephones, running red lights and many other types of dangerous behaviour deserve attention?

An undeniable drawback of this performance indicator is that no change has been found with respect to the number of crashes that occur in relation to self-reported driving while tired or nodding off. Although self-reporting (such as the Karolinska Sleepiness Scale) is frequently used by various studies to identify fatigue, the results of this performance indicator are difficult to interpret in relation to safety conditions.

Recommendation of the team of analysts:

The team of analysts proposes that a systemic analysis consider the issue of rested drivers before a decision is made about whether to retain the performance indicator.

High valuation of road safety

International expert panel, 2010 report:

“Valuation of road safety is, in its present form, an performance indicator which is somewhat difficult to interpret. It does not have any obvious relationship to the number of fatalities.... It

would perhaps be more informative to survey the attitudes to safety among policy makers.... The current annual survey of opinions about road safety in Sweden shows widespread support for legislation that politicians hesitate to pass. It would be interesting to learn more about why politicians hesitate to introduce even measures that are widely supported. Adding such a survey to the current survey of citizens would enhance the value of this safety performance indicator.”

It is obvious that this performance indicator has no directly quantifiable correlation with the number of fatalities or injuries and that this type of measurement has great potential for development.

Recommendation of the team of analysts:

A new valuation index should be devised that reflects all other performance indicators to be monitored until 2020. The index should be monitored in an annual analytical report but not serve as or be referred to as a performance indicator.

5.3 New set of performance indicators

A new set of performance indicators is proposed based on the above comments about the Performance indicators under revision and the analysis of road safety trends until 2020.

Each road safety performance indicator reflects a particular traffic condition. Each performance indicator is associated with an effort to monitor accident trends in the area. For example, the number of inebriated road users involved in fatal crashes and very severe injuries (RPMI 10 %) is studied along with the performance indicator of sober road users. The approach permits ongoing quality control of the correlation between the trends of the performance indicator and the number of fatalities and very severe injuries.

The assessment is that all performance indicator targets presented below must be achieved by 2020 in order to ensure overall target fulfilment. Falling short of the target for a particular performance indicator can have major repercussions because the effects of another performance indicator may be dependent on its achievement. This dynamic applies to the targets for both fatalities and very severe injuries.

A number of areas of intervention deserve special attention as part of the effort to reduce the number of very severe injuries, particularly in urban areas. The team of analysts points to the following conceivable performance indicators: Percentage of safe intersections in urban areas, percentage of bicycle traffic on GCM¹¹ paths in urban areas, percentage of safe GCM¹ crossings in urban areas, and percentage of bicycle traffic on well-maintained GCM¹ paths. GNS Road chose the last two options as Performance indicators 9 and 10 (see below).

A number of the performance indicators below are referred to as “safe”. Worth noting, however, is that a car, motorcycle, road or GCM¹ crossing is not thereby safe in the absolute sense of the word. The term “safe” should be regarded only in relation to the definition of the performance indicator. For example, the performance indicator of “safe motorcycles” is defined as those equipped with ABS.

¹¹ Abbreviation for pedestrian, bicycle and moped.

Performance indicators 1 and 2: Compliance of speed limits on the state-owned and municipal road networks

Performance indicator	Previous status quo 2007	Status quo, 2010	Previous target for 2020	New target for 2020 after review
Percentage of traffic volume within the speed limit, state-owned road network	43 %	Approximately 43 %	80 %	80 %

Performance indicator	Previous status quo, 2007	Status quo, 2010	Previous target for 2020	New target for 2020 after review
Percentage of traffic volume within the speed limit, municipal road network	52 %	Approximately 52 %	80 %	80 %

The assessment of the team of analysts is that the percentage of traffic within the speed limits is approximately the same as for the latest national studies in 2003 and 2004. However, there are strong indications that the average speed has declined. Not only was a comprehensive speed limit reform carried out in 2008-2009, but the results of the speed index – which monitors more general changes – reflect a clear decline.

The ambitious target of the original management by objectives proposal for greater compliance of speed limits must be maintained if the stronger interim targets for 2020 are to be achieved. According to the assessment, average speeds on both the state-owned and municipal road networks must decrease by more than 5 per cent in 2010-2020. For the state-owned road network, such a reduction can be accomplished if all remaining roads with a speed limit of 90 kilometres per hour receive a new speed limit of 80 kilometres per hour and are equipped with automatic speed cameras. In addition, a general reduction of 3 per cent in average speed is needed; this can be achieved by means of automatic speed cameras, manual surveillance and other types of measures for the purpose of altering road user behaviour.

The assessment of the team of analysts is that a reduction of just over 5 per cent in average speed would require approximately 80 per cent of drivers to begin obeying the speed limit. While the target is the same as before, the status quo is different given that speed limits are lower now. For these performance indicators, in other words, 80 per cent essentially represents a stronger target.

The team of analysts wants to emphasise that the above targets are rough estimates based on rather sparse data. Once the 2012 speed study – which will provide more complete data – has been completed, these targets may be revised in preparation for the first post-review follow-up at the 2013 results conference.

Performance indicator 3: Sober road users

Performance indicator	Previous status quo, 2007	Status quo, 2010	Previous target for 2020	New target for 2020 after review
Percentage of sober road users	99.71 %	99.74 %	99.90 %	99.90 %

Alcohol-related crashes claimed 65 fatalities in 2010. Better infrastructure, a greater percentage of safety systems in cars and other measures unrelated to alcohol would prevent approximately half of such fatalities. The residual (fatalities and very severe injuries that remain after the projection for 2020) contains the potential for reducing fatalities among

road users who are under the influence of alcohol by 31. Ten of them are bicyclists or pedestrians, leaving 21 drivers of motor vehicles whose lives would be saved by an improvement in the performance indicator.

Achievement of the proposed interim targets for 2020 would require at least nine fewer fatalities due to alcohol and nine fewer very severe injuries. Such reductions correspond approximately to a 99.90 per cent target, the same as the present one, for the performance indicator of sober road users.

Because estimates in this area are uncertain and approximate, the team of analysts is proposing that GNS Road consider the option of raising the target for the performance indicator to 100 per cent. A stronger target would not only ensure as great a reduction as possible of fatalities in this area, but perhaps be closer to the true desirable level.

Performance indicator 4: Use of seat belts

Performance indicator	Previous status quo, 2007	Status quo, 2010	Previous target for 2020	New target for 2020 after review
Percentage of belted passengers in the front seat of cars	96 %	96 %	99 %	99 %

The prediction generated by the analysis for cars in 2020 assumes that 90 per cent of traffic volume will consist of vehicles with effective seat belt reminder systems. If the entire traffic volume consists of vehicles with effective seat belt reminder systems, studies indicate that the use of seat belts may be assumed to reach 99 per cent. However, the prediction projects that 5 per cent of traffic volume in 2020 will consist of vehicles without seat belt reminder systems. Furthermore, there is reason to believe that this particular 5 per cent would benefit the most from seat belt use given that older cars are more often involved in crashes.

Among the crashes expected to remain in 2020 if no measures are taken above and beyond the prediction, 14 fatalities and 38 very severe injuries will occur as the result of failure to use seat belts. They will not be prevented by means of seat belt reminder systems by 2020. The target is for additional measures to reduce the number of fatalities by 4 and severe injuries by 18 due to greater use of seat belts in vehicles without reminder systems. Such improvement would require 99 per cent use of seat belts, which only effective measures in this area can ensure.

The analysis demonstrates that consumption of alcohol and the use of seat belts largely overlap. Thus, there is good reason to analyse these areas of intervention together. Many passengers who are not wearing seat belts at the time of a fatal accident are inebriated. Thus, a measure intended to increase the percentage of sober road users could have a major positive impact on seat belt use.

Performance indicator 5: Use of helmets

Performance indicator	Previous status quo, 2007	Status quo, 2010	Previous target for 2020	New target for 2020 after review
Use of bicycle helmets	27 %	27 %	70 %	65 %
Use of moped helmets	Unknown	Measured in 2012	Not available	Waiting for measurement

Use of bicycle helmets:

The target for 2020 is a 50 per cent reduction in the number of fatalities and very severe injuries that occur as the result of failure to wear bicycle helmets. Fatalities are to be reduced from 6 to 3 and very severe injuries from 29 to 14. Use of bicycle helmets was 27 per cent in 2010; elimination of deaths and very severe injuries when helmets were not used would generate a target for the performance indicator of 100 per cent. The proposed 50 per cent reduction generates a target of just under 65 per cent.

The estimate proceeds from the estimate that there is a linear correlation between helmet use and deaths/very severe injuries. The assumption is reasonable given that fatal crashes do not appear to be overrepresented by extreme cases suggesting that any particular group fails to wear helmets.

Use of moped helmets:

Proper use of helmets by mopedists would lead to an average of 3 fewer fatalities. Thus, the target of reducing the number of fatalities by at least one by 2020 is reasonable without establishing a 100 per cent target for the performance indicator. It would be difficult to set a target for the performance indicator until data collection has begun. Data collection for use of moped helmets is starting in 2012, after which a suitable target will be set for the performance indicator.

Performance indicator 6: Safe cars in road traffic

Performance indicator	Previous status quo, 2007	Status quo, 2010	Previous target for 2020	New target for 2020 after review
Percentage of traffic volume with the highest safety rating according to the European New Car Assessment Programme (Euro NCAP)	20 %	35 %	Not the same	80 %

The analysis estimates the effects of a number of different new safety systems that can be expected to be widespread in new cars by 2020. Many such systems can be identified by monitoring the percentage of cars with the highest safety rating according to Euro NCAP. Based on the assumptions that have been made concerning replacement of cars and the safety systems that will be introduced, 74 per cent of traffic volume is expected to consist of safe cars (the highest safety rating according to Euro NCAP) in 2020. An additional target for replacing the oldest cars with new ones has also been set. Accelerating the replacement of old and unsafe cars in this way would reduce fatalities by 6 and very severe injuries by 8. A target of 80 per cent is regarded as necessary to achieve that level.

Performance indicator 7: Safe motorcycles in road traffic – anti-lock braking system (ABS)

Performance indicator	Previous status quo, 2007	Status quo, 2010	Previous target for 2020	New target for 2020 after review
Percentage of motorcycles in traffic equipped with ABS	9 %	18 %	Not the same	70 %

This project defines a safe motorcycle as one equipped with ABS. Greater knowledge in the future may justify an adjustment of the definition.

Based on the current replacement rate, the prediction assumes that 59 per cent of motorcycles in traffic in 2020 will be safe. Above and beyond that level, an additional reduction of one in the number of fatalities and three in the number of very severe injuries must be achieved by 2020. One way of achieving the target would be for all new motorcycles to be equipped with ABS by 2015, or for greater implementation to begin now. In that case, the performance indicator would reach 70 per cent by 2020.

Performance indicator 8: Safe state-owned roads

Performance indicator	Previous status quo, 2007	Status quo, 2010	Previous target for 2020	New target for 2020 after review
Percentage of traffic volume on roads with speed limits above 80 kilometres per hour that are divided	50 %	67 %	75 %	100 %

The percentage of safe state-owned roads is monitored by looking at the percentage of traffic volume on roads with speed limits above 80 kilometres per hour for which the road is also divided.

The prediction proceeds from the somewhat conservative assumption that all roads with speed limits of 90 kilometres per hour, circulation of more than 4,000 vehicles per day and a width of at least 12 metres will be divided by 2020. The corresponding performance indicator level would be 75 per cent. The speed limit on remaining stretches that have lower circulation or are narrower than 12 metres would have to be reduced to 80 kilometres per hour. Assuming that such changes are possible by 2020, the old target for the performance indicator can be raised from 75 to 100 per cent.

The definition of the performance indicator also permits achievement of the target simply by reducing speed limits, though not generating the same effect as the expansion of road division assumed by the prediction. Thus, it is important to monitor the expansion of road division by means of a separate surveillance measurement.

Performance indicator 9: Safe pedestrian, bicycle and moped (GCM) crossings in urban areas

The performance indicator captures a substantial percentage of bicycle fatalities and very severe injuries at GCM¹² crossings. The performance indicator offers a potential reduction of three fatalities and eleven very severe injuries if all GCM¹ crossings in the main municipal road network have speed bumps. According to the assessment, a reduction of two fatalities and eight very severe injuries would be required to achieve the proposed targets.

¹² Abbreviation for pedestrian, bicycle and moped.

Knowledge is available about the correlation between speed bumps and the effect on the target. The transition to GCM¹ crossings with speed bumps would reduce the number of very severe injuries among bicyclists and pedestrians by 80 per cent. A GCM¹ crossing with a speed bump is one in which a collision between a car and a pedestrian or bicyclists does not exceed 30 kilometres per hour.

The performance indicator is part of the current set. A method for monitoring the performance indicator is under development and is based on reviews by individual municipalities of GCM¹ crossings with speed bumps, as well as reporting to the National Road Database. The development method has not yet yielded sufficient data to follow the performance indicator; the delay must be dealt with if the performance indicator is to continue being used. It is important that the future effort ensure that the performance indicator has a target and that it can be monitored by means of proper measurement.

Performance indicator 10: Operation and maintenance of GCM¹ paths

The performance indicator captures a large percentage of the many very severe injuries in single crashes. The potential of the performance indicator is a reduction of very severe injuries by 25 (seven of which on winter roads) if GCM¹ paths were wholly free of loose gravel, pits, bumps and slippery surfaces. The assessment is that a 40 per cent decrease in the number of very severe injuries by 2020 would require eliminating 11 of the 25 crashes.

Knowledge is lacking about the correlation between specific measures in this area and the number of crashes and injuries that occur. Just because a particular place is slippery or bumpy does not mean that maintenance has been inadequate in terms of current standards.

No measurement method has been developed for this performance indicator. Measurement is rendered more difficult by the lack of a simple method for pinpointing that which is useful to monitor. If measuring the percentage of bicycle traffic on properly maintained GCM¹³ paths is regarded as infeasible, a better approach would be to monitor the outcome (percentage of fatalities and very severe injuries for which insufficient road maintenance is the likely cause). It is important that the future effort ensure that the performance indicator have a target and that it can be monitored by means of proper measurement.

5.4 New measurements to supplement the performance indicators

In addition to the proposed performance indicators, the following measurements are suggested as a means of more fully describing road traffic conditions.

Percentage of fatal crashes for which fatigue is a contributing factor

The assessment by the analysis is that 11 fatalities will occur in 2020 due to crashes in which fatigue was a contributing factor. Given the potential for reducing the number of crashes due to fatigue until 2020, clearly monitoring trends in this area is a reasonable ambition. The problem is that it is essentially impossible to measure the percentage of traffic volume that involves a tired driver. As a result, monitoring fatal crashes instead is a suitable strategy. The proposed measurement is the “percentage of fatal crashes for which fatigue was a contributing factor.”

¹³ Abbreviation for pedestrian, bicycle and moped.

Percentage of fatal crashes for which distraction or lack of visibility was a contributing factor

The assessment by the analysis is that 59 fatalities will occur in 2020 due to crashes in which fatigue or lack of visibility is a contributing factor. Such a large potential illustrates the fact that many crashes begin due to some type of distraction or inattention on the part of the driver. It goes without saying that a number of different measures can interrupt the chain of events before the adverse effect of death occurs. Thus, there is a great overlap between the 59 traffic fatalities in this potential and other areas of intervention.

Given the large potential for reducing the number of crashes due to distraction or lack of visibility until 2020, clearly monitoring trends in this area is a reasonable ambition. As with fatigue, the problem is that it is essentially impossible to measure the problem of distraction in overall traffic volume. As a result, monitoring fatal crashes instead is a suitable strategy. The proposed measurement is the “percentage of fatal crashes for which distraction or lack of visibility was a contributing factor.”

Percentage of moped crashes for which tuning or technical flaws were a contributing factor

Reducing the number of moped crashes caused by tuning or technical flaws offers major potential. Monitoring tuning or technical flaws is not a reasonable option when it comes to moped traffic as a whole. The phenomena can be monitored through The Swedish Transport Administration’s in-depth studies instead; the measurement should be “percentage of moped fatalities for which tuning or technical flaws were a contributing factor.”

Valuation index

A valuation index corresponds to the current performance indicator of “high valuation of road safety” and monitors the attitude of the Swedish public to road safety measures. How high do citizens value the various performance indicator areas? The source of the index is The Swedish Transport Administration’s annual road safety questionnaire. The index will be further improved to meet demand.

5.5 Monitoring measurements

Monitoring measurements are those that should be monitored to ensure that we are heading in the right direction but that do not need to be presented openly every year. Each such measurement can be assigned to one of four categories:

Surveillance of predictions and areas of intervention

Surveillance of predictions and areas of intervention with the following: “The predictions assumed by the analysis (see Figure 4.1) must be subject to surveillance to ensure that they are realised, given their importance for target fulfilment in 2020.”

Surveillance of external factors

Suitable external factors to monitor are traffic volume trends by different means of transport. The risk posed by an increase in traffic volume depends on the means of transport involved – for example, the risk is greater for motorcycles than cars. The impact on safety caused by greater use of quad bikes is another example of increased risk that should be monitored.

Traffic volume trends for various age groups, such as young drivers, can also affect the level of risk in the road traffic system.

External surveillance should also monitor demographic trends, which affect the level of risk in the system as well. Monitoring fluctuations in the business cycle, as well as extreme weather conditions that occasionally have a major impact on the number of fatalities and very severe injuries, is also important.

Surveillance to ensure that safety standards are maintained

One assumption of the review analysis is that ongoing safety improvements are maintained. A safe road or vehicle is assumed to remain that way for its entire lifetime. While reasonable, the assumption may require surveillance in certain cases. For example, the extent to which a safety system for cars remains in use after being launched in the market should be subject to surveillance.

Surveillance of data quality

Injury data obtained from STRADA¹⁴ health care have previously been revalued because a number of emergency rooms had not reported. Now that nearly all emergency rooms report to STRADA, internal data loss is of great interest. Internal data loss refers to people who receive emergency care from a hospital that reports to STRADA but whose traffic injury is not reported for some reason. Internal data loss has proven to vary from one emergency room to another, and from time to time at the same emergency room. In order to interpret and understand variations in the number of severe injuries (RPMI 1 %) and very severe injuries (RPMI 10 %), internal data loss at STRADA health care must be monitored for each individual emergency room.

To monitor trends in accordance with the prediction for safety systems in vehicles, a register of the systems must be maintained. The Swedish Transport Agency currently has that responsibility.

¹⁴ Swedish Traffic Accident Data Acquisition System.

5.6 An overall list of the 10 new performance indicators

Figure 5.2 below presents the 10 new performance indicators as an overall list. The list shows the status quo in 2010 and the 2020 target for most performance indicators. Measurements and status quo data must be obtained for some of the performance indicators.

The new performance indicators are 2010-2020	Previous status quo 2007	New status quo, 2010	Previous target for 2020	New target for 2020	Comments
1. Compliance of speed limits, state-owned road network	43 %	Approximately 43 %	80 %	80 %	A stronger target in practice given that speed limits have been lowered.
2. Compliance of speed limits, municipal road network	52 %	Approximately 52 %	80 %	80 %	A stronger target in practice given that speed limits have been lowered.
3. Sober road users	99.71 %	99.74 %	99.90 %	99.90 %	Previous target sufficient to achieve new interim targets.
4. Use of seat belts	96 %	96 %	99 %	99 %	Some fatalities and injuries will occur in 2020 in cars without seat belt reminder systems among passengers who are still unbelted
5. Use of helmets					
- bicycles	27 %	27 %	70 %	65 %	Reduction of fatalities by 6 with 100 % use of helmets. Target of a 50 % reduction requires 65 % use.
- moped	Unknown	Measured in 2012	Not available	Waiting for measurement	Target must be developed. Waiting for first measurement, which is scheduled for 2012
6. Safe cars in road traffic	20 %	35 %	Not the same	80 %	Faster replacement of cars required to reach the target.
7. Safe motorcycles in road traffic (ABS)	9 %	18 %	Not the same	70 %	The current rate of motorcycle replacement would generate 59 % ABS in 2020 traffic.
8. Safe state-owned roads	50 %	67 %	75 %	100 %	Important to monitor the percentage of divided roads. The target can also be achieved by lowering speed limits.
9. Safe GCM ¹⁵ passages in urban areas	Approximately 25 %	Unknown	Not available	Missing	A measurement method has been developed but remains to be implemented. Target must be developed.
10. Operation and maintenance of GCM ¹ paths	Unknown	Unknown	Not available	Missing	Both a measurement method and target must be developed.

Figure 5.2. New set of indicators, including goals for 2010-2020.

¹⁵ Abbreviation for pedestrian, bicycle and moped.

6. Analysis of slip and fall crashes in road traffic environments

Because slip and fall crashes in road traffic environments are not regarded as traffic crashes, they were not included in the above analysis of targets and performance indicators. Nevertheless, slip and fall crashes account for very common and very severe injuries in road traffic environments. Thus, they should be an integral part of both the national and local joint road safety effort.

6.1 Minimising slip and fall crashes – part of the road safety effort

Current management of slip and fall crashes in the road safety effort

The safety target in the area of road transport has been specified in the form of two interim targets: reducing the number of fatalities by 50 per cent and the number of very severe injuries (RPMI 10 %) by 25 per cent between 2007 and 2020. Up to this point, the interpretation within the framework of joint management by objectives has been that the specified targets apply to traffic crashes in the area of road transport only. The interpretation was the basis of the analyses performed during the 2012 review of targets and performance indicators for 2020.

A road traffic accident is defined as an event that occurs on a road or street, involves at least one moving vehicle and causes personal injury or property damage. Thus, a pedestrian who slips or falls and is injured in road traffic environments is not regarded as having suffered a road traffic accident.

As discussed below, slip and fall accidents represent a very common phenomenon that leads to both deaths and very severe injuries. Thus, an overall perspective requires various interventions to monitor and minimise these injuries in the area of road transport. Minimising slip and fall crashes in road traffic environments should be an integral part of both the national and local joint road safety effort.

Local responsibility for preventing slip and fall accidents

Given that most slip and fall accidents occur on municipal streets, walkways and bicycle paths, as well as private and public property in urban areas, they are primarily a local problem. The chief responsibility of the municipalities is to perform winter and post-thaw road maintenance in a way that prevents slip and fall accidents on city streets, walkways, bicycle paths and public property.

Slipping accounts for a significant percentage of these crashes and should be given special attention. According to a decision of the Gothenburg City Council, for example, snow clearance and anti-slip treatment of most pedestrian surfaces is the responsibility of private property owners. Many property owners do not take any measures to remove snow or ice from walkways.

The Environmental Committee in Gothenburg is responsible for supervising and monitoring that area. The task has been assigned to a single person, who basically can intervene only when a complaint is received. Under severe winter conditions, there may be as many as 150

complaints a week. Preventive monitoring cannot be postponed. The Environmental Administration is able to fine property owners who fail to meet their obligations. No such fines have ever been issued. A person who is injured due to inadequate anti-slip treatment can file a claim. But the injured party must be aware of that possibility, take the initiative and know whom to file the claim against. According to Göteborgs Stads Försäkrings AB Göta Lejon statistics, only one-sixth of slip and fall accidents in road traffic environments are followed by a claim.

Not all municipalities have the same division of responsibility between the local authority and private property owners as Gothenburg does. In Stockholm, the municipality has taken over the responsibility from the property owners. The municipality is in charge of all snow removal and anti-slip treatment on public walkways. According to Swedish Association of Local Authorities and Regions statistics, approximately half of the country's municipalities have sole responsibility for maintenance of pedestrian surfaces in the winter.

Transport Research Institute (VTI) Report 735 concluded that an effort to categorise municipalities on the basis of type and size could not identify any difference in the number of injured pedestrians on the basis of whether the municipality or property owners managed maintenance of pedestrian surfaces in the winter. Categorising the municipalities on the basis of climate zone, however, suggested that the difference between municipalities and property owners is greatest in southern Sweden, somewhat narrower in central Sweden and narrowest in northern Sweden. But VTI calls for a more in-depth analysis that takes additional variables into consideration before concluding that municipal road maintenance reduces the number of injuries.

Need of targets for slip and fall accidents in road traffic environments

The current interim targets of reducing the number of fatalities by 50 per cent and very severe injuries by 25 per cent between 2007 and 2020 do not apply to slip and fall accidents in road traffic environments. The question is whether grounds exist for developing a national target for such accidents.

Considering that these accidents frequently involve older people, the National Board of Health and Welfare's proposed national action plan for initiatives to promote the safety of the elderly can be a good place to start. The action plan notes that no national targets have been approved for slip and fall accidents. The plan proposed the following targets for reducing the number of slip and fall accidents, whether in road traffic environments or elsewhere: "The upward trend will be arrested such that there will be fewer fatalities among the elderly due to slip and fall accidents in 2020 than in 2011."

One reason for the fairly modest target is that statistics reveal such an upward trend among both women and men. The plan does not propose a target for the number of injuries due to slip and fall accidents.

One reason for not developing a national target for slip and fall accidents in road traffic environments at this time is that it is a brand new issue not included in the present assignment of reviewing current targets and performance indicators. Another reason is that slip and fall accidents are primarily a local problem given that most of them occur on municipal streets, walkways and bicycle paths, as well as public property in urban areas. In other words, the responsibility of establishing public policy targets for reducing the number of such accidents devolves largely on the municipalities.

A third reason is that no thorough analysis has performed concerning the potential for minimising fatalities and very severe injuries from slip and fall accidents in road traffic environments. Data are lacking about the magnitude of the problem when it comes to fatalities, and no analyses have been performed to identify the ways that extreme winters and rising life expectancy will affect the number of fatalities and very severe injuries as the result of slip and fall accidents in road traffic environments.

The other side of the coin is that such accidents represent a public health problem that would benefit from an explicit national target. The fact that the Government requested a separate study of slip and fall accidents when commissioning the action plan from the National Board of Health and Welfare also supports the need for such a target. The proposed national action plan that the National Board of Health and Welfare submitted in December 2011 recommends that special attention be paid to very severe injuries among unprotected elderly road users, including interventions to prevent slip and fall injuries in road traffic environments.

Furthermore, interventions to reduce the number of slip and fall accidents in road traffic environments also have a positive impact on other transport policy targets. The reason is that such contributions improve basic, good-quality accessibility, reliability, safety, security, gender equality, ability to choose public transport, walking and bicycling, and health.

Thus, the following conclusion can be drawn. There are strong reasons for municipalities to adopt local targets for reducing or minimising an increase in the number of fatalities and very severe injuries from slip and fall accidents in road traffic environments. Although there may be grounds for adopting a national safety target in the area, such a proposal is outside the constraints of this project. Developing a proposal for a national target would require further investigation, an important starting point for which should be the Government's response to the National Board of Health and Welfare proposed action plan to promote safety among the elderly.

6.2 Description of the status quo

Fatalities due to slip and fall accidents in road traffic environments

No reliable statistics are available about fatalities due to slip and fall accidents in road traffic environments. The Cause of Death register suffers from quality flaws with respect to the site of the accident, as well as whether slipping and falling were involved.

The statistics in STRADA¹⁶ health care are also highly deficient in terms of recording fatalities caused by slip and fall accidents in road traffic environments. Only a handful of such fatalities are reported to STRADA each year. Given that there were 4,700 very severe injuries (RPMI 10 %) in 2010 and that many elderly were involved, the true number should be considerably higher.

Nine out of ten fatal slip and fall accidents involve the elderly. There were 1,500 such fatalities among people age 65 and older in 2010. Fifty thousand people in that age group were hospitalised and 90,000 went to an emergency room. In most cases (53,000), the site of the accident was in or near the home (ordinary residence). Ten thousand slip and fall accidents occurred on streets, pavements or other stretches, and 17,000 in hospitals or assisted living facilities. Assuming that the number of fatalities is distributed in approximately the same

¹⁶ Swedish Traffic Accident Data Acquisition System.

way, a rough estimate suggests that there are 100-300 fatalities due to slip and fall accidents in in road traffic environments every year.

According to the plan for promoting safety among the elderly that the National Board of Health and Welfare proposed to the Government in 2011, current trends and Statistic Sweden's demographic projections permit the following prediction for the number of fatalities due to slip and fall accidents (whether in in road traffic environments or elsewhere). No dramatic increase in the number of fatalities is expected for the 65-74 age group. Given the current effort to promote safety, however, the number of fatalities in the 75-84 age group due to slip and fall accidents is expected to more than double over the next 30 years.

As shown below, slipping and falling of all types represent a predominant cause of fatal accidents. As opposed to other kinds of accidents, women account for a high percentage of slip and fall fatalities.

Very severe injuries due to slip and fall accidents in in road traffic environments

Below is an examination of the number of very severe injuries due to slip and fall accidents in in road traffic environments for 2010. Worth noting is that weather conditions were relatively severe throughout Sweden in 2010, which presumably affected the number of slip accidents. Keep in mind also that the key used to reclassify the injuries entered in STRADA health care to the number of very severe injuries is the same one that was used in the analysis of traffic accidents. Given that slip and fall accidents involve the elderly to a much larger extent than traffic accidents, a reasonable assumption is that the number of very severe injuries from such accidents is underreported.

According to STRADA, 11,920 pedestrians were injured due to slip and fall accidents in in road traffic environments in 2010. Considering that not all emergency rooms reported injuries to STRADA in 2010, the actual number may be assumed to have been 14,500. Of the approximately 3,900 severe injuries among pedestrians due to slip and fall injuries, 370 were very severe. In other words, more than one-quarter of slip and fall accidents cause some degree of permanent disability.

Almost one-tenth of very severe injuries lead to medical impairment of at least 10 per cent. The focus below is wholly on the number of pedestrians who were very severely injured due to slip and fall accidents in 2010. Generally speaking, however, the percentage differences are not particularly large between studying RPMI 1 per cent and 10 per cent.

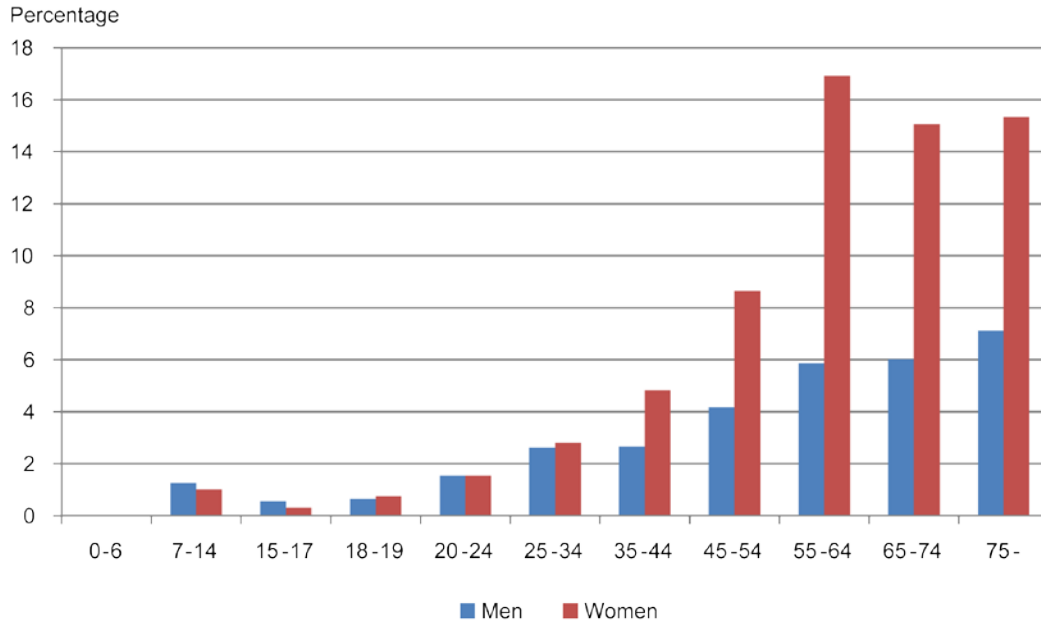


Figure 6.1. Very serious injuries due to slip and fall injuries in traffic environments in 2010, broken down by age and gender. Source: STRADA

Sixty-seven per cent of people with very severe injuries due to slip and fall accidents were women. Seventy-nine per cent of all injuries were among people age 45 or older. The 65 and older age group accounted for 66 per cent of all injuries. The number of injuries in the 55 and older age group rose particularly rapidly among women. See Figure 6.1.

Figure 6.1 below shows that 39 per cent of all very severe injuries in slip and fall accidents occurred when road conditions were described as “snow and ice”. However, the category of Unknown also includes many slip and fall accidents attributed to slippery conditions. Including these cases, 68 per cent of all very serious slip and fall accidents in 2010 were due to slipping. Keep in mind, however, that more slip accidents presumably occurred in 2010 than a normal year.

Only some 4 per cent of all very severe injuries in 2010 were attributed to holes or pits as the road condition or cause. According to a VTI report, bumpiness accounts for approximately 10 per cent of all injuries in a normal year.

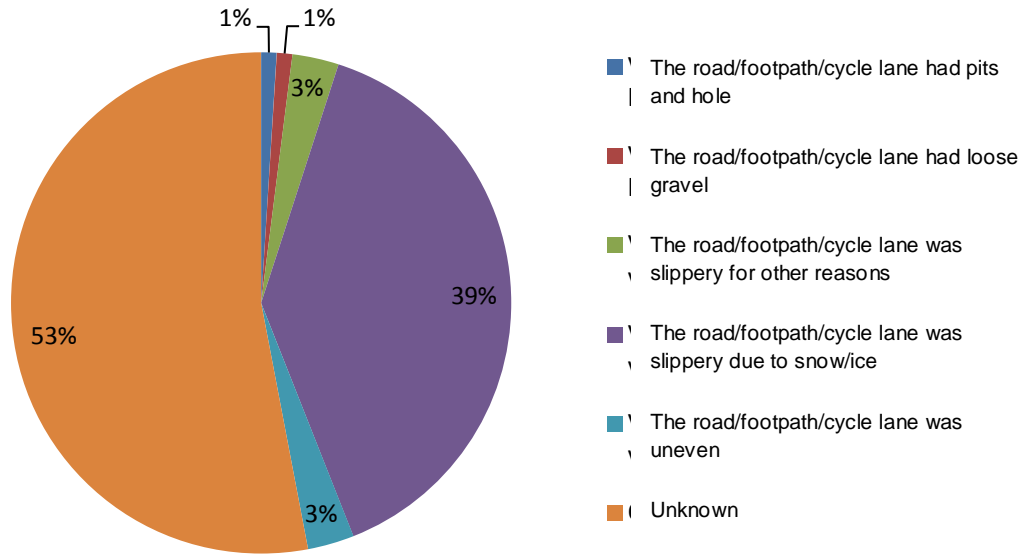


Figure 6.2. Very severe injuries (RPMI 10 %) due to slip and fall accidents in road traffic in 2010, broken down by the reason for slipperiness. Source: STRADA.

Better maintenance of winter roads is important for all age groups, especially age 45 and older. Better summer road maintenance is most important for the 55 and older age group. Half of all very severe injuries occur on walkways, pedestrian and bicycle paths, and public squares. One-quarter occur on streets and intersections. Approximately one-tenth are reported on private property.

Figure 6.3 below shows that one-third of all very severe injuries in the road transport system in 2010 were from slip and fall accidents, more than the number of very severe injuries among passengers. More than half of the very severe injuries to women were caused by slip and fall accidents.

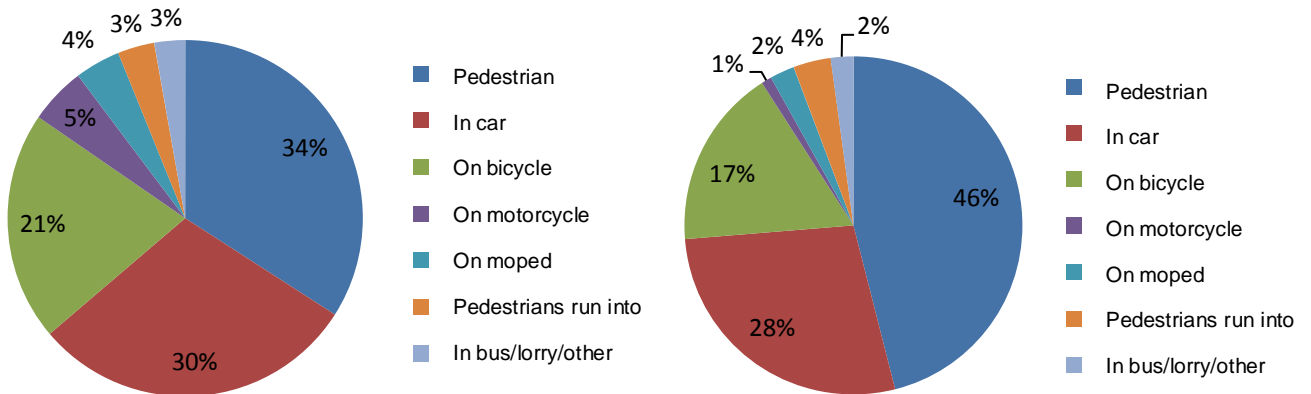


Figure 6.3. Very severe injuries (RPMI 10 %) in the road transport system due to traffic accidents and slip and fall accidents in traffic environments. The diagram on the right reports the same figures for women only. Source: STRADA.

6.3 Areas of intervention and new measurements for slip and fall accidents in in road traffic environments

Priority areas of intervention

Based on available information about minimising slip and fall accidents in in road traffic environments, measures that focus on pathways, public squares, bus stops and other places where many elderly congregate are particularly important. Following are some areas of intervention in which measures are required.

- Effective maintenance of pedestrian surfaces in the winter
- Effective summer road maintenance of pedestrian surfaces
- Proper design, materials and equipping of pedestrian surfaces
- Proper shoes, anti-slip devices and walkers
- Informational efforts and consumer guidance

Winter and summer road maintenance represents the two most important interventions for preventing slip and fall accidents among pedestrians. These areas of intervention are very important in minimising both single-bicycle and slip and fall accidents. In other words, the same areas of intervention can be used to minimise a large group of very serious road injuries.

For a positive impact to occur, however, winter and summer road maintenance for pedestrians and bicyclists will have to be much more effective than is currently the case. Presumably no more money is needed, but rather new priorities for existing resources.

Municipal road maintenance services and property owners must establish criteria in the following areas if winter and summer road maintenance is to be effective.

- Proper standard demands
- Proper measures on spots
- Management by quality control
- Consumer reports of problems

New performance indicators for slip and fall accidents in in road traffic environments

The key to minimising slip and fall accidents in in road traffic environments consists of local measures by municipalities and property owners. National performance indicators could provide support for greater commitment and clear priorities at the local level. But any national performance indicator for slip and fall accidents in in road traffic environments should proceed from measurements of local conditions on the basis of certain qualitative requirements.

One way to measure improvements in municipal winter and summer road maintenance would be to conduct a survey among all municipalities based on pre-established criteria. That way the criteria that various municipalities meet could be identified. As more municipalities meet the criteria, the risk for slip and fall accidents should decline.

The measurements could not only be used in the national road safety effort, but presented in the Open Comparisons of Safety and Security published by the Swedish Association of Local Authorities and Regions.

The following two performance indicators could be relevant:

- Percentage of municipalities that effectively maintain pedestrian surfaces in the winter.
- Percentage of municipalities with effective summer road maintenance of pedestrian surfaces

7. An overall assessment of the analysis

The targets can be achieved, but the stakeholders concerned must rally behind them and effective measures must be taken. The conclusions presented below do not represent a formal position on the part of the stakeholders but rather what their representatives on GNS Road¹⁷ have come up with based on the analysis.

7.1 Challenging targets fuel change

Ambitious targets are vital to encouraging the development of new ways to reduce the number of fatalities and very severe injuries (RPMI 10 %) in road traffic. As the effort to achieve the interim target for 2007 revealed, ambitious targets help unite the stakeholders, create greater commitment and focus and raise awareness about new problems and solutions.

The fact that the target was not achieved until 2010 could be regarded as a failure, but not if the process that the effort set in motion is taken into consideration. The work involved in achieving the target contributed to innovation and technical progress that is driving much of the positive road safety trends now under way.

Among the solutions for which challenging targets are partly responsible are divided 13-metre wide roads, installation of automatic speed cameras and improvement of the underlying strategy, Swedish involvement in Euro NCAP, develop of several different safety systems in vehicles, safer crossings in urban areas and speed limit reform. Looking ahead, major challenges clearly remain when it comes to improved compliance of speed limits, safety of unprotected road users and implementation of new vehicle safety technology.

The risk of a challenging target is that the road safety effort can be construed as a failure if it falls short. Those with political and operational responsibility can suffer negative publicity as a result. However, an interim target should not be seen simply as a number that must be reached by a particular year. The most important purpose of an interim target may actually be to serve as a catalyst of change by encouraging the development of new and innovative solutions.

The EU has called for a 50 per cent reduction in traffic fatalities for an additional 10-year period. Sweden is regarded as a road safety leader both in and outside of the EU. The fact that the country has argued for ambitious targets in various international venues should be taken into consideration when setting targets for 2010-2020.

7.2 Discussion of the analysis

The new targets are challenging but realistic

A key conclusion of the analysis is that improvements to vehicles, as well as infrastructure to a lesser extent, will significantly contribute to the effort to reduce the number of fatalities and very severe injuries (RPMI 10 %) in road traffic until 2020. This analysis is based on a prediction that considers the measures that have been incorporated into various plans – measures, in other words, that will most likely have an impact during the period. Generally

¹⁷ Group for National Collaboration – Roads

speaking, such trends will help reduce the number of fatalities and very severe injuries among motorists.

Given Sweden's transport policy targets, there are a number of reasons to focus on the effort to improve safety for unprotected road users. One major challenge in achieving the targets for 2020 will be to increase the number of pedestrians and bicyclists while improving their safety. In particular, the number of very severe injuries among bicyclists must be reduced. They already account for approximately one-third of very severe injuries in traffic accidents and the percentage will rise significantly unless the effort focuses more on their safety. In addition to pedestrians and bicyclists, other unprotected road users – mopedists and motorcyclists – deserve more attention.

According to the prediction, current trends should reduce the number of annual fatalities by approximately 100 until 2020. Looking at the expansion of traffic volume, demographics and annual averages in 2009-2011, the number of traffic fatalities must be reduced by approximately 70 more on an annual basis in order to achieve the target of no more than 133 in 2020. All things considered, the road safety effort needs to aim at reducing the number of annual fatalities by 170 until 2020, which would correspond to the EU target of reducing the number of traffic fatalities by 50 per cent in 2010-2020. A 50 per cent reduction by 2020 would require 15 to 20 fewer fatalities per year. A reduction from 266 to 133 fatalities would require more than 7 per cent fewer every year until 2020.

The number of traffic fatalities declined by 50 per cent in 2000-2010. The figure was relatively high (570) at the beginning of the period and an historical low point (266) at the end of the period. The decline was more than 7 per cent yearly and 52 per cent for the entire period. Note that suicide is reported separately and has been eliminated from official statistics starting in 2010. Including suicide, there were 283 road traffic fatalities in 2010 – which contributed to the 50 per cent reduction since 2000. The annual decrease remains at 7 per cent.

In addition to the measures included in the prediction, the stakeholders concerned will have to take additional initiatives if the number of annual fatalities is to decline by approximately 10 in 2013-2020. That kind of effort should be possible, but it will not be easy. By way of comparison, The Swedish Transport Administration's guidelines for intervention in the state-owned road network call for 5 fewer fatalities in 2012 as well as 10 fewer fatalities in both 2013 and 2014. The desire for greater focus on the safety of unprotected road users makes the effort to achieve these targets more uncertain and challenging. Such measures require knowledge and clarification with respect to causal relationships, strategies, responsibility and financing above and beyond that which is needed in the case of motorist safety.

All in all the targets of reducing the number of fatalities by 50 per cent and very severe injuries by 40 per cent in 2010-2020 are deemed to be realistic but challenging. Retaining the current interim targets for fatalities would hardly be challenging given that the prediction shows present trends leading to approximately 200 road traffic fatalities in 2020. In other words, the analysis points to the conclusion that no measures above and beyond those that have been included in the plans are needed to meet the current targets.

Figure 7.1 below illustrates alternative targets for road traffic fatality trends until 2020.

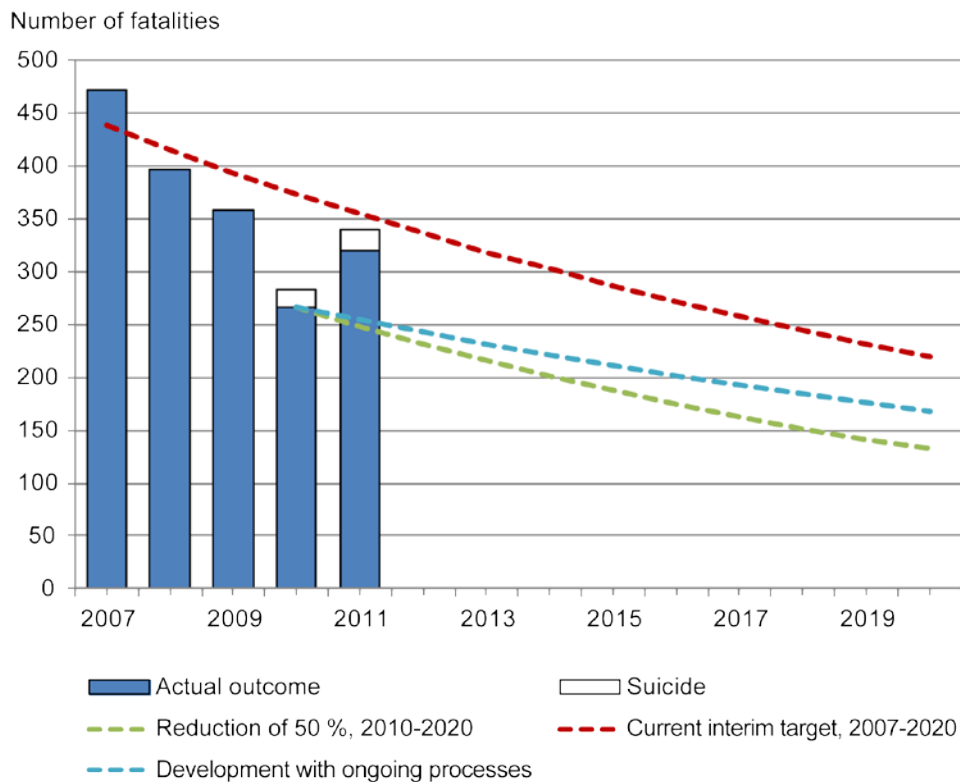


Figure 7.1. Actual road traffic fatality trends in 2007-2011, as well as three alternative curves until 2020 corresponding to previously the established interim target, trends corresponding to the prediction and trends corresponding to a possible new interim target.

The new targets require active management by objectives

The new targets require active management by objectives. Thus, the national stakeholders in the Towards Vision Zero - Together project must actively support regional and local organisation such that the proper measures are taken in an appropriate and timely manner. For this reason, it is important that GNS Road continue to identify measures and priority areas of intervention that are central to achieving the targets. That should be done in the context of the annual report compiled by the national team of analysts.

However, this is unlikely to suffice. The road safety effort of regional and local stakeholders must play a more prominent role in order for the targets to be achieved. Thus, the national results conference should be followed by regional conferences on specific measures to be taken. The purpose of these conferences would be to proceed from the priorities identified by GNS Road to discuss measures and areas of intervention with the municipalities, police, regional planners, Swedish Transport Agency, The Swedish Transport Administration and other regional and local stakeholders.

The analysis shows not only that the targets should be strengthened, but that the road safety effort needs to focus on new areas of intervention and refocus in certain respects. The analysis demonstrates in particular that the effort to reduce the number of very serious bicycle injuries requires greater emphasis. Minimising the number of very serious slip and fall injuries in road traffic environments is also important from an overall perspective. Better maintenance of walkways and bicycle paths is integral to that effort, thereby increasing the role of municipalities and regional planners when it comes to road safety. A need then arises to

develop training programmes for the national and regional stakeholders concerned. Such training is probably essential if effective measures are to be implemented for the new areas of intervention that have been identified.

7.3 Measures required to achieve the new targets

Below are some of the measures required to achieve the new targets. The purpose of the summary is to proceed from current knowledge and experience to identify the measures required to achieve the targets specified in the analysis when it comes to reducing the number of fatalities and very severe injuries (RPMI 10 %). The summary also points to critical success factors and special challenges that should be taken into consideration as the effort continues.

Measures for monitoring and supporting trends in line with the prediction

Measures are required to monitor and support the realisation of trends in line with the prediction. For instance, those in charge of infrastructure must ensure that the roads are readable by new car safety systems and that vehicle inspectors assume responsibility for upholding the function of optional systems as well. Registers of car safety systems are also needed. The Swedish Transport Agency has already been tasked with following the development of these systems. Such registers may be needed by insurance companies and vehicle inspectors in addition to serving as a general tool for monitoring trends. Another possible measure to support realisation of the prediction would be to strengthen national requirements for cars and transport as new safety systems are launched in the market.

Proceed with and optimise the infrastructure and speed limit effort

Improving the state-owned infrastructure, including speed limits, is integral to the potential for reducing the number of fatalities. One proposal currently under discussion is to eventually eliminate 70 and 90 kilometre per hour speed limits. If such reforms are carried out, roads that currently have 90 kilometre per hour speed limits would be divided or lowered to 80 kilometres per hour. The speed limit on a large percentage of roads that currently have 70 kilometres per hour could be lowered to 60 kilometres per hour.

The potential to improve safety by dividing roads would remain but to a lesser extent. The effort to strengthen guard rail protection must continue.

Cost-effective measures at intersections are needed. According to the analysis, serious accidents in intersections account for many of the road safety problems that will remain once the measures included in the prediction have been taken. Among the measures that need to be considered are safer design, dynamic speed limits or other Intelligent Transport Systems and Services (ITS) solutions.

Measures that target the municipal infrastructure, including speed limits, will be an extremely important ingredient of the potential to achieve the targets, particularly when it comes to reducing the number of very severe injuries among unprotected road users. Among the key measures are lowering the base speed limit in highly developed areas from 50 to 40 kilometres per hour, the introduction of 30 kilometre per hour areas, GCM¹⁸ crossings with speed bumps, effective winter and summer road maintenance of GCM¹ paths, ongoing construction of roundabouts and ongoing construction of bicycle paths.

¹⁸ Abbreviation for pedestrian, bicycle and moped.

Traffic surveillance and monitoring commercial traffic

Improved compliance of speed limits is the road safety performance indicator or area of intervention with the greatest potential for helping to achieve the targets. Automatic speed cameras are regarded as the most important tool for exploiting that potential. Greater use of automatic speed cameras in the state-owned road network would be particularly effective on the 80 kilometre per hour stretches. New and expanded use of automatic speed cameras is also needed in the commercial road network, especially the 40 and 60 kilometre per hour stretches.

The police and municipalities must proceed with the Cooperation against Alcohol and Drugs in Traffic (SMADIT) project. The number of breathalyzer tests – as well as surveillance of speed, seat belt use and moped helmet use – probably need to remain at the same level. Road users with extreme behaviour are likely to represent a growing percentage of road safety problems. Traffic surveillance is a key measure in that connection. Controlling and monitoring commercial traffic will be important given that speeding violations have not declined to the same extent as among other categories of vehicles.

Improvement of vehicles and protective equipment

Most new car safety systems are expected to have a major impact during the period. However, there are serious road safety problems for which the plans do not contain any solutions and for which progress should be initiated or supported. Illegally operating a car or motorcycle constitutes one such problem. One solution may be suspending driving licences or a similar measure.

Another key challenge is to minimise the number of tired and distracted drivers. An effort is under way in this area. The Government has tasked VTI with proposing measures for improving safety in connection with mobile telephone use. SAFER and other stakeholders are studying problems and solutions associated with distraction. Improvements to bicycles, including brakes and other systems, should also continue. Another challenge is identifying tools to boost the supply and demand for shoes with better anti-slip properties.

Developing measures to influence the behaviour of road users

Many of the performance indicators require road users to be motivated and understand the value of particular behaviours, such as obeying speed limits, driving while sober and helmet use. Awareness and motivation can be promoted in various ways, frequently by combining infrastructure measures with legislation, education and informational campaigns. Knowledge of how to conduct educational efforts and informational campaigns has grown in recent years. The work on improvements to driver training and continuing education needs to continue. Such an approach can make it easier for road users to actively choose behaviour that improves road safety at both the operational and strategic level.

Some groups of road users, particularly in the area of commercial traffic (such as haulers and other businesses heavily engaged in the transport of passengers or goods), have established venues for communicating safety information. These venues require support in developing policies and regulations. Education, information and assistance in developing tools for improved road safety are all important methods. The same is true for those who procure transport services. A number of venues can benefit from various types of educational support activities.

The target of 70 per cent bicycle use by 2020 has been lowered to 65 per cent. The target has actually been strengthened given that no associated legal requirement is being proposed. The previous demand for helmet legislation appears to have blocked effective initiatives for promoting voluntary helmet use. The new target requires more effort by stakeholders concerned when it comes to identifying creative ways of encouraging voluntary use of bicycle helmets.

Municipalities to have a more prominent role in achieving the targets for very severe injuries

Refocusing on injuries gives municipalities a significantly expanded role in the national road safety effort. A number of measures within the municipal sphere of responsibility are particularly important in achieving the targets for very severe injuries. As shown in Figure 7.2 below, a potential has been calculated within several areas of intervention for reducing the number of fatalities above and beyond the prediction. The municipalities have a potential to eliminate at least 15 per cent of the fatalities (69) required each year above and beyond the prediction. Similarly, the municipalities have a potential to eliminate approximately 40 per cent of the very severe injuries (210) required each year above and beyond the prediction.

New legal requirements and financial incentives to be considered

New legal requirements are not currently regarded as a necessary prerequisite for achieving stronger targets. However, adjustments to existing rules would probably facilitate implementation of effective measures when it comes to modifying bicycle regulations and speed limits. The bicycling investigation is considering right of way regulations at intersections, which is linked to the safe design of GCM crossings. The evaluation of new speed limits is looking at the issue of base speed limits in and on the outskirts of urban areas.

Scrapping older vehicles that meet only low safety standards has a major potential for helping to reduce the number of fatalities. A new rule concerning premiums for scrapping such vehicles would probably be an effective measure in that regard. Other areas in which legal requirements may require consideration is prevention of illegal driving and dealing with the extreme group that drives too fast, under the influence or without using seat belts. More intelligent insurance policies and stricter penalties should also be considered in this connection.

Key challenges

Measures to improve compliance of speed limits and reduce average speeds, including lower speed limits, have the greatest potential for promoting achievement of the targets. Thus, effective measures for achieving infrastructure targets in the area of speed limit compliance, are critical. The installation of automatic speed cameras is considered to be the single most effective tool for improving compliance of speed limits. Among the challenges is to maintain the ability of the system to reduce average speeds and to further develop the system's capacity and level of technology. It is also important to encourage voluntary installation of intelligent speed adaptation (ISA) systems in vehicles as a means of supporting drivers.

Technological progress for car safety systems will make a strong contribution to reducing the number of road traffic fatalities and injuries over the next 10-20 years. Some of that progress will require improvement of the state-owned and municipal infrastructure, including roads that car safety systems can read. Car inspectors will play a key role in monitoring the function of optional car safety systems as well.

Single-bicycle accidents appear to pose a daunting challenge. Additional analyses are needed to outline the problem, identify cost-effective measures, devise implementation strategies, etc. Cooperation between the state and municipalities needs improvement in this area. More knowledge is required when it comes to effective winter and summer road maintenance of GCM¹⁹ paths. Minimising slip and fall accidents should also be considered in this connection.

The analyses identifies the promotion of sober driving as an area for which the targets should be high. The question is whether the target of 99.9 per cent for the performance indicator of sober road users is reasonable given the measures currently available. The new generation of non-contact breath alcohol ignition interlock devices is not likely to have a significant impact during the period. The assessment is that additional tools to discourage driving under the influence of alcohol and drugs are required.

Identifying ways of dealing with tired and distracted drivers, as well as extreme groups that drive illegally, too fast, under the influence or without using seat belts poses important challenges in the ongoing road safety effort.

Summary of performance indicators and key measures

Figure 7.2 below summarises the proposal of the analysis for the targets associated with the various performance indicators, as well as important key measures above and beyond those included in the prediction that are needed to reduce the number of fatalities by 50 per cent until 2020.

The measures already included in the prediction mostly concern the performance indicators of safe cars in traffic, safe motorcycles in traffic, safe state-owned roads and safe GCM¹ crossing in urban areas. The automotive industry, The Swedish Transport Administration and municipalities all have a vital role to play in carrying out the measures included in the prediction. The additional measures required involve infrastructure, car safety systems, surveillance and road user behaviour.

Keep in mind that the summary below concerns fatalities. For example, the performance indicators of safe GCM¹ crossings in urban areas and operation & maintenance of GCM¹ paths would have accounted for approximately 25 per cent of the potential for reducing the number of very severe injuries, as opposed to approximately 8 per cent for reducing the number of fatalities.

Performance indicator	Status quo 2007	New targets 2020	Target for reduction of fatalities above and beyond the prediction	Percentage	Key stakeholders	Key measures
1. Compliance of speed limits, state-owned road network	43 %	80 %	22	32	The Swedish Transport Administration Police	90 to 80 kilometres per hour Automatic speed cameras Surveillance Influence
2. Compliance of speed limits, municipal road network	52 %	80 %	5	7	Municipalities Police Regional planners	50 to 40 kilometres per hour Reconstruction Automatic speed cameras Surveillance Influence

¹⁹ Abbreviation for pedestrian, bicycle and moped.

Performance indicator	Status quo 2007	New targets 2020	Target for reduction of number of fatalities above and beyond prediction	Percentage	Key stakeholders	Key measures
3. Sober road users	99.71 %	99.9 %	9	11	Police Municipalities Swedish Transport Agency Industry	Surveillance SMADIT Breath alcohol ignition interlock devices Influence
4. Seat belt use	96 %	99 %	4	6	Police	Surveillance Influence
5. Helmet use Bicyclists	27 %	65 %	3	4	Municipalities The Swedish Transport Administration Automotive industry	Influence
5. Helmet use, mopedists			1 1 (tuning)	3	Municipalities The Swedish Transport Administration Automotive industry	Influence Surveillance
6. Safe cars in road traffic	20 %	80 %	6 (scrapping)	9	State	State financial incentives
7. Safe motorcycles in road traffic (ABS)	9 %	70 %	1	1	Automotive industry	Influence
8. Safe state-owned roads	50 %	100 %	2	3	The Swedish Transport Administration Regional planners Swedish Transport Agency	Reconstruction of stretch Reconstruction or ITS solution in intersection
9. Safe GCM ²⁰ passages in urban areas	Approximately 25 %	Missing	2 3 (run over when backing up or turning)	7	Municipalities Regional planners	Reconstruction
10. Operation and maintenance of GCM paths	Unknown	Missing	1	1	Municipalities Property owners The Swedish Transport Administration	Effective maintenance of winter roads Effective summer road maintenance
Other targets according to the analysis			2 fatigue 3 distraction 5 illegal driving	11	Automotive industry State	Car safety systems Surveillance Suspension of motorcycle licences Penalties for serious offences
<i>Total</i>			69	100		

Figure 7.2. Summary of proposed indicators and current conditions, infrastructure goals for 2020, goal for reduction of number of fatalities above and beyond the prediction, and measures and organisations integral to achieving the goals.

²⁰ Abbreviation for pedestrian, bicycle and moped.

7.4 Need for new information and ongoing development

New information about correlations between safety measures and their effects, and effective measures

Our knowledge about that which impacts the number of fatalities among both protected and unprotected road users is relative thorough and includes many good-quality correlations between safety measures and their effects. New information has emerged recently concerning the risk of death (Lundastudien 2011) and the impact of various protection devices (Sternlund 2011) when pedestrians are run over at various speeds.

Corresponding information is lacking for severe injuries or very severe injuries (RPMI 10 %) based on data reported by hospitals. Some previous studies, including Rune Elvik's study based on statistics reported by the police, have been compiled. Analyses indicate that police and healthcare data differ with respect to correlations between safety measures and their effects (Gummesson 2012). Nevertheless, risks of injury in terms of speed, type of road or street, etc., have been established for pedestrians, bicyclists and mopedists who collide with motor vehicles

Single-bicycle collision represent the biggest risk for bicyclists. Knowledge is lacking about underlying causes or appropriate methods of preventing such accidents and the very severe injuries they give rise to. We also need to improve our understanding of the impact of external factors and develop new systems that can influence consumer and producer behaviour to benefit these groups of road users.

The situation is similar when it comes to slip and fall accidents in road and street environments. More knowledge is needed about maintenance of winter pedestrian surfaces.

Dissemination existing knowledge about effective measures and priority areas of intervention

The stakeholders concerned are not taking full advantage of much of the knowledge that is already available. Proceeding from the analysis that has been performed and the performance indicators that have been proposed for the ongoing road safety effort, relevant knowledge should be compiled, disseminated and applied. Given the fresh challenges facing the road safety effort, some form of training for employees and decision makers at the stakeholders concerned would be valuable.

Develop methods for collecting and analysing data

Socioeconomic analyses and valuations of safety among unprotected road users need to be devised. STRADA's quality requires improvement to minimise data loss. The ability to extract the number of severe injuries and very severe injuries at the regional and local level as well represents another important issue that affects STRADA. Quantification methods are needed for many of the performance indicators and measurements that the analysis has identified.

7.5 Overall conclusions of the analysis

The following conclusions can reasonably be drawn on the basis of the analysis that has been performed.

Need for new targets and performance indicators

- Revision of the interim target to a maximum of 133 fatalities in traffic crashes in 2020 would be desirable considering that it is both realistic and challenging. A key consideration in making this assessment is the fact that a prediction anticipates an outcome below the interim target without taking any measures above and beyond those included in existing plans. The new interim target would match the EU target of reducing the number of traffic fatalities by 50 per cent in 2010-2020.
- Possible to achieve a revised interim target of reducing the number of severe injuries (RPMI 1 %) in traffic crashes by 25 per cent in 2010-2020.
- Possible to achieve a revised interim target of reducing the number of very severe injuries (RPMI 10 %) in traffic crashes by 40 per cent in 2010-2020. That would match the European Parliament's target of reducing the number of life-threatening injuries by 40 per cent during the same period.
- The targets should be achievable by taking effective measures that require neither more money than the current road safety effort nor new regulations in addition to those that ongoing investigations may propose.
- A new set of ten performance indicators, as well as additional measures to be monitored on an annual basis, are proposed as a means of managing and monitoring the road safety effort at the national level.

Need for additional measures

- Technological progress in car safety systems, as well as infrastructure to a lesser extent, will strongly contribute to target fulfilment. Generally speaking, such trends will help reduce the number of fatalities and severe injuries (RPMI 1 %) among motorists.
- Thus, improving safety for unprotected road users will be among the biggest challenges. In particular, the number of very severe injuries (RPMI 10 %) among bicyclists must be reduced. Minimising the number of very serious slip and fall injuries in road traffic environments is also important from an overall perspective. Operation and maintenance must be considerably better for both bicyclists and pedestrians. All in all, the role of municipalities in the road safety effort will expand as a result.
- Another key challenge is to promote greater compliance of speed limits on both the state-owned and municipal road networks. The degree of success will have a major impact on the ability to achieve the new targets.
- Among other challenges are effectively minimising alcohol and drug use, as well as fatigue, distraction and extreme behaviour in traffic.
- Fresh knowledge and expertise are needed to meet the challenges faced by the road safety effort of the future.

Need for more effective management by objectives

- New measurements need to be developed for a number of the proposed performance indicators. Only then will the performance indicators be able to exercise a guiding influence on the effort. The Swedish Transport Administration is coordinating the quantification of these performance indicators.
- GNS Road should continue identifying priority measures and areas of intervention in the context of the annual report compiled by the national team of analysts.
- Regional conferences could be launched for the purpose of proceeding from the priorities identified by GNS Road to initiate broad-based consultation about measures and areas of intervention on which various regional and local stakeholders – particularly the municipalities, police, regional planners, Swedish Transport Agency and The Swedish Transport Administration – can collaborate.
- A training programme for stakeholders concerned would be useful at the national, regional and local levels as a means of supporting adoption of effective measures within various areas of intervention.

7.6 An overall assessment by GNS Road

Below are the conclusions that GNS Road has drawn from the analysis. The conclusions do not represent the official standpoints of the stakeholders involved but were drawn by their representatives on GNS Road based on the analysis.

Reasons for performing an analysis

- The Government has previously stated that a more thoroughgoing review of the target structure should be conducted in 2012 and 2016.
- Current trends suggest that the target of no more than 220 fatalities in 2020 does not constitute a major challenge.
- The EU has adopted the target of a 50 per cent reduction in the number of fatalities between 2010 and 2020.
- Not all components of previous analytical methods and performance indicators are sufficient any longer.
- New measures have emerged that must be assigned targets, and new problems have appeared.
- Organisations are setting more ambitious targets.

Conclusions from the analysis that has been performed

1. The analysis, which presents conceivable trends from 2010 to 2020 with respect to the number of fatalities and very severe injuries (RPMI 10 %) in traffic crashes, is reliable and offers a solid basis for priorities in the ongoing road safety effort.
2. Strengthening the targets in the manner specified by the analysis is deemed to be realistic while sufficiently challenging to encourage innovative solutions to road safety problems.
3. According to the team of analysts, the set of performance indicators for the joint road safety effort should be revised.

4. Trends in the area of vehicle and infrastructure safety technology will strongly contribute to target fulfilment for 2020. Improving compliance of speed limits and the safety of unprotected road users is among the additional challenges.
5. Achievement of the targets identified by the analysis requires efficient management by objectives and new knowledge, especially with respect to improving the safety of unprotected road users.

Appendix 1: Workshop participants

Following are the participants at the workshop held on 10 February 2012 to discuss the analysis of new targets and performance indicators for the road safety effort.

<i>Organisation</i>	<i>Name</i>
Autoliv	Ola Boström
Folksam	Helena Stigson, Matteo Rizzi
IF Skadeförsäkring	Irene Isaksson-Hellman
Lund University of Technology	András Varhelyi
Swedish Automobile Association	Niklas Stavegård
National Society for Road Safety	Mats Carlsson
National Police Board	Liselotte Jergard, Bengt Svensson
Swedish Association of Local Authorities and Regions	Hanna Lamberg, Patrik Wirsenius
Swedish Motorcyclists Association	Jesper Christensen, Maria Nordqvist
City of Stockholm	Anna-Sofia Welander
Swedish National Association of Driving Schools	Berit Johansson
Swedish Association of Road Transport Companies	Ulric Långberg
The Swedish Transport Administration	Claes Tingvall, Erik Norrgård, Kent Nyman, Per-Olov Grummas Granström, Ylva Berg, Magnus Lindholm, Roger Johansson, Johan Strandroth, Helena Höök, Lars Darin, Johan Lindberg
Swedish Transport Agency	Sofia Gjerstad, Jan Ifver
Swedish National Road and Transport Research Institute	Astrid Linder, Anna Vadeby

Appendix 2: Abbreviations and terms in the report

<i>Term</i>	<i>Explanation</i>
ABS	Anti-lock braking system – a technical system that prevents the wheels of a vehicle from locking when the brakes are engaged.
Severe injury	A personal injury that causes permanent medical impairment of health equivalent to a medical impairment of 1 % or more (RPMI 1 %).
ATK	Automatic speed camera
GCM	Abbreviation for pedestrian, bicycle and moped.
GNS Road	Group for National Collaboration – Roads (GNS Road). A venue for knowledge exchange and coordination among various stakeholders for the purpose of realising Vision Zero in the area of road transport.
Performance indicator	A quantifiable measure of a road traffic condition that is important to affect in order to reduce the number of fatalities and severe injuries.
RPMI	Risk of Permanent Medical Impairment (RPMI) in Road Traffic Crashes, an international risk indicator.
SMADIT	Cooperation Against Alcohol and Drugs in Traffic. Collaboration among the police, municipal social services and other authorities. A person who is reported for driving or operating a boat under the influence can obtain rapid assistance free of charge through the municipality.
STRADA	Information system for crashes and injuries throughout the road transport system: Swedish Traffic Accident Data Acquisition System. STRADA is based on data from the police and healthcare system. The police report traffic crashes – for the entire country starting in 2003. Most Swedish emergency rooms report traffic accident data.
Very severe injury	A personal injury that causes permanent medical impairment of health equivalent to a medical impairment of 10 % or more (RPMI 10 %).
Road traffic accident	An event that occurs in traffic on a road or street that involves at least one moving vehicle and causes personal injury or property damage.

Appendix 3: Parameters and definitions in the analysis

<i>Parameters and definitions for predictions</i>			
Parameters	Prediction for 2020	Criterion for prediction fatalities	Criterion for prediction very severe injuries (RPMI 10 %)
Divided roads	Roads wider than 12 metres that accommodate more than 400 vehicles per day are divided with median dividers.	An accident that has taken place on a road that will be divided in 2020, which is considered likely to have prevented it or made it considerably less serious. Swerving into the next lane and loss of control of heavy vehicles excluded.	An accident that has taken place on a road that will be divided in 2020, which is considered likely to have prevented it or made it considerably less serious. 100 % effect on collisions or when passing another car has been assumed.
Electronic stability control (ESC) – anti-skid	100 % in new cars as of 2008	The car was manufactured in a year when the system was standard. The accident was due to oversteering, which could have been avoided by ESC. Extremely careless behaviour excluded.	The car was manufactured in a year when the system was standard. 30 % reduction of injuries in cars on winter roads and 6 % reduction of injuries in cars on dry and wet roads.
Lane departure warning (LDW) system	100 % in new cars as of 2015	The car was manufactured in a year when the system was standard. The accident was caused by swerving into the next lane and could have been avoided by LDW. Visible lines that are readable by an LDW system are a requirement, excluding crashes in the rain, etc. Extremely careless behaviour excluded.	The car was manufactured in a year when the system was standard. 50 % reduction of injuries that cause injuries. Only single-car crashes and collisions on dry and wet roads with speed limits above 70 kilometres per hour are considered relevant.
Seat belt reminder systems (SBR)	100 % in new cars as of 2009 (front seat) and 2015 (back seat)	The car was manufactured in a year when the system was standard. The impact of the collision was such that the fatality could have been avoided through use of a seat belt. Assessment performed by a coroner.	The car was manufactured in a year when the system was standard. 80 % of unbelted passengers put on a belt with SBR. Risk of injury is reduced by 46 % for RPMI 1 and 60 % for RPMI 10.
SBR LB (Seat belt reminder systems in lorries, heavy and light)	100 % in new cars as of 2011	The car was manufactured in a year when the system was standard. The impact of the collision was such that the fatality could have been avoided through use of a seat belt. Assessment performed by a coroner.	The car was manufactured in a year when the system was standard. 80 % of unbelted passengers put on a belt with SBR. Risk of injury is reduced by 46 % for RPMI 1 and 60 % for RPMI 10.
Electronic stability control (ESC) TLB – anti-skid in heavy lorries	100 % in new lorries as of 2015	The lorry was manufactured in a year when the system was standard. The accident was such that it could have been avoided with ESC.	Same criteria as ESC for cars, but same analytical strategy as for fatal crashes. Each description of an accident by the police or healthcare system was studied the same way as for fatal crashes because the quantity was manageable.
Lane departure warning (LDW) system for heavy lorries (TLB)	100 % in new lorries as of 2015	The lorry was manufactured in a year when the system was standard. The accident was such that it could have been avoided by LDW. Visible lines that are readable by an LDW system are a requirement, excluding crashes in the rain, etc. Extremely careless behaviour excluded.	Same criteria as LDW for cars, but same analytical strategy as for fatal crashes. Each description of an accident by the police or healthcare system was studied the same way as for fatal crashes because the quantity was manageable.

Parameter	Prediction for 2020	Criterion for prediction fatalities	Criterion for prediction very severe injuries (RPMI 10 %)
AEB Upp TLB (Automatic emergency braking system for frontal collisions)	100 % in new cars as of 2015	The car was manufactured in a year when the system was standard. The accident was such that it could have been avoided or been much less severe with an automatic emergency braking system for frontal collisions.	The accident was such that it could have been avoided or been much less severe with an automatic emergency braking system for frontal collisions. Each description of an accident by the police or healthcare system was studied the same way as for fatal crashes because the quantity was manageable.
ABS MC (Anti-lock braking systems on motorcycles)	100 % on new motorcycles as of 2017. 50 % as of 2010 when estimating severe injuries (RPMI 1 %).	The motorcycle was manufactured in a year when the system was standard. The accident is such that it could have been avoided with ABS, i.e., loss of control due to braking was a critical event.	The motorcycle was manufactured in a year when there is a certain probability that the system was standard. 38 % of all motorcycle injuries.
FCW pb (Front collision warning system for cars)	100 % in new cars as of 2015	The car was manufactured in a year when the system was standard. The frontal collision was such that it could have been avoided or made much less severe with an automatic emergency braking system for frontal collisions.	67 % reduction of frontal collisions.
Pb collision safety	10 years, new cars	The impact of the collision was such that the fatality would have been avoided in a car that was manufactured ten years later.	1 % risk reduction for severe injuries (RPMI 1 %) per year yields 10 % risk reduction in ten years. For RPMI 10, the same risk reduction is 1.25 %.
Intersections in urban areas	50 % of intersections in urban areas with functional road classification 3-5 have roundabouts	The accident took place at an intersection that will have a roundabout in 2020 and could have been prevented or made considerably less severe if there had been a roundabout.	100 % reduction of injuries with the exception of frontal collisions.
GCM crossings in urban areas	20 % of GCM crossings in urban areas with functional road classification 3-5 have speed bumps	The accident took place at a crossing that will have speed bumps in 2020 and could have been prevented or made considerably less severe if there had been speed bumps.	53 % reduction of RPMI 1 and 78 % reduction of RPMI 10.
AEB pb for C (Automatic emergency braking system in cars to prevent running over bicyclists)	100 % in new cars as of 2015	The car was manufactured in a year when the system was standard. The accident was such that it could have been avoided or made much less severe with an automatic emergency braking system for bicyclists.	50 % reduction of injuries among bicyclists.
AEB pedestrian (Automatic emergency braking system in cars to prevent running over pedestrians)	100 % in new cars as of 2015	The car was manufactured in a year when the system was standard. The accident was such that it could have been avoided or made much less severe with an automatic emergency braking system for pedestrians.	50 % reduction of injuries among pedestrians.

Parameter	Prediction for 2020	Criterion for prediction fatalities	Criterion for prediction very severe injuries (RPMI 10 %)
Pedestrian protection 21 p	100 % in new cars as of 2015 will have at least 21 points in the Euro NCAP pedestrian test.	Not applied to fatal crashes.	Pedestrian test of a car that ran over a pedestrian is compared with future 21 points. 4.6 % risk reduction per higher point for RPMI 1 and 9 % risk reduction per higher point for RPMI 10.
Breath alcohol ignition interlock device programme (for people convicted of driving under the influence)		Drivers with known alcohol problems who drove their own car and who died in an accident due to a mistake caused by the driver.	Not applied to severe injuries (RPMI 1 %).
Whiplash protection	50 % in new cars as of 2001, 80 % in new cars as of 2006	Not applied to fatal crashes.	10 % risk reduction with frontal collisions in cars manufactured as of 2000 and 20 % risk reduction in cars manufactured as of 2005.

<i>Parameters and definitions for areas of intervention</i>			
Measure/area of intervention	Potential for 2020	Criterion, potential for fatalities	Criterion, potential for very severe injuries (RPMI 10 %)
Speed reduction, municipal road network, 3-8 %	Total compliance of speed limits corresponds to an 8 % reduction of average speed.	Potential estimated on the basis of the power model and with all crashes in the state-owned road network in the residual in the base. In other words, the potential is estimated on the basis of a general correlation.	
Speed reduction, state-owned road network, 3-8 %	Total compliance of speed limits corresponds to an 8 % reduction of average speed.	Potential estimated on the basis of the power model and with all crashes in the municipal road network in the residual in the base. In other words, the potential is estimated on the basis of a general correlation.	
Replacement of vehicles, alternative 1	All cars more than 20 years old are scrapped and replaced by cars with new technology (ESC, LDW, SBR and AEB + 21p)	Same reduction of fatal crashes as cited for these systems in the above table.	Same reduction of severe injuries (RPMI 1 %) as cited for these systems in the above table.
Replacement of all vehicles, alternative 2	All cars more than 15 years old are scrapped and replaced by cars with new technology (ESC, LDW, SBR and AEB + 21p)	Same reduction of fatal crashes as cited for these systems in the above table.	Same reduction of severe injuries (RPMI 1 %) as cited for these systems in the above table.
100 % New motorcycles equipped with ABS, 2015	100 % in new motorcycles as of 2015	Same reduction of fatal crashes as cited for this system in the above table.	Same reduction of severe injuries (RPMI 1 %) as cited for this system in the above table.
Divided roads with lower circulation	Roads wider than 12 metres and with circulation of <u>less than</u> 4,000 vehicle/day are divided	Same reduction of fatal crashes as cited for this system in the above table.	Same reduction of severe injuries (RPMI 1 %) as cited for this system in the above table.
Better guard rail protection at speed limits of 80 kilometres per hour or higher		Crashes for which the impact of the collision could have been reduced drastically if an object, tree, etc. had not been on the side of the road.	Crashes for which the impact of the collision could have been reduced drastically if an object, tree, etc. had not been on the side of the road.
GCM crossings with speed bumps, 50-100 % of functional vehicle classification 3-5		Same reduction of fatal crashes as cited for this system in the above table.	Same reduction of severe injuries (RPMI 1 %) as cited for this system in the above table.
Breath alcohol ignition interlock device programme		Same reduction of fatal crashes as cited for this system in the above table.	Not applied to severe injuries (RPMI 1 %).
Unguarded level crossings secured	Unguarded level crossings removed.	100 reduction in number of road users run over in unguarded level crossings.	100 reduction in number of road users run over in unguarded level crossings.
Reconstruction, turning off and backing up	All places where unprotected road users are run over by heavy vehicles that are turning off or backing up are rebuilt to avoid that.	100 % reduction in the number of unprotected road users who are run over by heavy vehicles that are turning off or backing up.	100 % reduction in the number of unprotected road users who are run over by heavy vehicles that are turning off or backing up.
Use of seat belts	Everyone who was injured or killed while not wearing a seat belt would have been belted.	Same reduction of fatal crashes as cited for this system in the above table.	Same reduction of severe injuries (RPMI 1 %) as cited for this system in the above table.

Measure/area of intervention	Potential for 2020	Criterion, potential for fatalities	Criterion, potential for very severe injuries (RPMI 10 %)
Increased percentage of sober road users		The accident was caused by a road user who was under the influence, regardless of the category of road user.	
Proper helmet use, motorcyclists	Everyone who was injured or killed while not wearing a helmet would have been wearing a helmet.	Accident in which the road user was not wearing a helmet properly and for which an injury occurred due to their neglect to wear a helmet properly.	14 % reduction of RPMI 1 and 69 % reduction of RPMI 10 for those who wear helmets.
Proper helmet use, mopedists	Everyone who was injured or killed while not wearing a helmet would have been wearing a helmet.	Accident in which the road user was not wearing a helmet properly and for which an injury occurred due to their neglect to wear a helmet properly.	17 % reduction of RPMI 1 and 47 % reduction of RPMI 10 for those who wear helmets.
Proper helmet use, bicyclists	Everyone who was injured or killed while not wearing a helmet would have been wearing a helmet.	Accident in which the road user was not wearing a helmet properly and for which an injury occurred due to their neglect to wear a helmet properly.	1.2 % reduction of RPMI 1 and 17 % reduction of RPMI 10 for those who wear helmets.
Tuned moped	Everyone who was killed on a tuned moped would have had an untuned moped.	Accident in which the moped was tuned and injury could have been avoided if the moped had been untuned.	Not applied to severe injuries (RPMI 1 %).
Fatigue		Accident that began with a course of events during which the driver's fatigue is suspected to have substantially contributed to the accident.	Not applied to severe injuries (RPMI 1 %).
Distraction/visibility		Accident that began with a course of events during which the driver obviously did not see or notice something essential.	Not applied to severe injuries (RPMI 1 %).
Extreme behaviour		Accident that began with a course of events during which the driver or other road users who were killed behaved in an extremely careless manner (such as extreme speeding).	Not applied to severe injuries (RPMI 1 %).
Driving licence/illegal driving		The driver of the vehicle in which somebody was killed was not authorised to drive that vehicle.	Not applied to severe injuries (RPMI 1 %).
Summer road maintenance of GCM paths		Not applied to fatal crashes.	The cause of the accident is deemed to have been inadequate summer road maintenance.
Winteroperation of GCM paths		Not applied to fatal crashes.	The cause of the accident is deemed to have been inadequate winter road maintenance.

Measure/area of intervention	Potential for 2020	Criterion, potential for fatalities	Criterion, potential for very severe injuries (RPMI 10 %)
Safe bicycle paths		The accident took place on a bicycle path that was not separated from car traffic and that was the cause.	The accident took place on a bicycle path that was not separated from car traffic and that was the cause.
Operation and maintenance, state-owned road network		Inadequate operation and maintenance was a decisive cause of the accident.	Not applied to severe injuries (RPMI 1 %).
Measures, single-bicycle crashes		The accident was a single-cycle accident.	The accident was a single-cycle accident.

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