Preparatory work for an EU road safety strategy 2020-2030

Final Report

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SWOV and Loughborough University

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Table of Contents

Acknowledgements 6
Disclaimer 6
Abstract 7
Executive Summary 8
1 Introduction 14
1.1 Objectives, outline of tasks, approach and methodology 14
1.2 Report structure 18
2 The context for road safety in the EU 18
2.1 The EU role 18
2.2 External factors and emerging social and mobility trends 20
2.2.1 Economic trends and the amount of travel 20
2.2.2 An ageing population 21
2.2.3 New urban mobility patterns 21
2.2.4 Continuing popularity of powered two wheelers 22
2.2.5 Cooperative, connected and automated vehicles 22
2.2.6 Electro-mobility 24
2.2.7 Mobile communication technologies 25
2.3 Increasing ambition for better road safety results 25
2.3.1 The global context 25
2.3.2 EU ambitions 26
2.3.3 The Safe System goal and approach 26
2.4 Safe System and key safety performance indicators (KPIs) 29
2.4.1 Introduction 29
2.4.2 What are key safety performance indicators (KPIs)? 29
2.5 Aligning road safety with other societal goals and objectives 32
3 Current status of road safety in the European Union and future prospects 34
3.1 Introduction 34
3.2 Results 34
3.2.1 Final outcomes: road deaths, serious injuries, value of prevention 34
3.2.2 Intermediate outcomes 41
3.3 Interventions and institutional delivery 41
4 Recommendations for new EU road safety strategy 44
4.1 Suggested title: 44
4.2 Scope: 44
4.2.1 Overview of approach 44
4.3 Key elements of the strategy 45
4.3.1 The context for road safety in the European Union 45
4.3.2 The current situation and future prospects 46
4.3.3 Road safety performance framework and related institutional delivery ..47
4.4 Recommended work for further development of the 2020-2030 strategy 84
LIST OF ANNEXES 86
Annex 1: Summary of SAE International's Levels of Driving Automation for On-Road Vehicles Issued January 2014, SAE international's 87
Annex 2: Methodology for estimating the effects of the recommended KPIs and summary of results 88
Annex 3: EU Road Safety Activity 2015-2017 111
Annex 4: Summary of Recommendations 114

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Disclaimer

Abstract

The European Commission is preparing an EU road safety strategy for the period 2020 to 2030 and towards zero deaths by 2050. It has commissioned preparatory work carried out by Jeanne Breen Consulting in partnership with SWOV and Loughborough University's Design School to assist in this process. The Commission set three objectives to be addressed: 1) assess the outcome of the road safety policy framework to 2017, building on the interim evaluation carried out in 2015; 2) consider current and future changes in mobility and its consequences and challenges in relation to road safety; and 3) assist in the preparation of the EU road safety framework for 2020-2030. The preparatory work comprised:

- a systematic, high-level scan of activity to date within the framework of *Policy Orientations* across good practice road safety management dimensions of *results*, *interventions* and *institutional management*;
- an assessment of future prospects based on a review of emerging social and mobility trends; increased ambition for better road safety results; increasing adoption of the Safe System approach internationally; increasing scope of institutional delivery and opportunities for aligning with other societal objectives.
- proposals for a Towards Zero strategy 2020-2030 around a new road safety performance framework and enhanced delivery mechanisms.

Executive Summary

BACKGROUND AND STUDY AIMS:

Substantial progress has been made in reducing road deaths across the EU over the last two decades, aided by goal, target and strategy setting. Between 2000 and 2017 there has been a 56% reduction in road deaths. The EU is the leading world region in road safety and its performance is recognised as an international success story. In 2010, the European Commission introduced the current road safety strategy - *Policy Orientations on Road Safety 2011-2020* which set out an ambitious quantitative target to reduce the number of annual road deaths by 50% between 2010 and 2020. The following year, a Transport White Paper set out a highly ambitious long-term goal of virtually eliminating road deaths by 2050 – a *Vision Zero* for EU road safety activity and envisaged the setting of a quantitative target to reduce road injuries. In a series of seven broad strategic objectives, *Policy Orientations* set out a range of policy priorities, intervention fields and policy instruments to provide a framework for activity towards the 2020 target. In 2015, the Commission carried out a comprehensive interim evaluation of progress to date supported by an independent evaluation.

The Commission is now taking stock of activity to date to prepare the way for a new road safety strategy for the period 2020 to 2030 and towards zero deaths by 2050 and has commissioned this study to assist in this process. The Commission has set three objectives to be addressed in this study to 1) assess the outcome of the road safety policy framework until the end of 2017, building on the interim evaluation carried out in 2015; 2) consider current and future changes in mobility and its consequences and challenges in relation to road safety; and 3) assist in the preparation of the EU road safety framework for 2020-2030.

CURRENT STATUS OF ROAD SAFETY IN THE EU:

Building on the previous assessment, a systematic, high-level scan has been carried out of EU road safety activity within the framework of *Policy Orientations* across the good practice road safety management dimensions of *results*, *interventions* and *institutional management*.

Results: progress in reducing road deaths against the 2020 target and serious injuries
Each year, over 99% of total transport passenger deaths result from road crashes. In 2016, 25,600 people were killed in road collisions across the EU 28 with 25,300 deaths reported provisionally for 2017. While continuing annual reductions have been achieved, the rate of road safety progress has slowed over the last three years. Since 2010, a 20% reduction in death has been achieved which makes meeting the 2020 target to reduce deaths by 50% highly challenging, if not improbable. To achieve the road safety target for 2020, an annual reduction 14.6% is required compared with the average annual 3.4% reduction achieved between 2010 and 2016. External factors contribute to these results as does the scope, quality, and amount of systematic intervention and institutional delivery. Whilst research indicates that economic recession worked positively for road safety in the EU between 2007 and 2009, the recent stronger economic development is likely to be one of the key factors in the recent slowing of road safety progress.

The world's best road safety performers are to be found within EU countries and most Member States have improved their road safety records since 2010. However, there is

a threefold gap in road death rates between the better and worse road safety performers. Average mortality over the last three years varies between 27 and 94 road deaths per million population, with an average of 51 road deaths per million in EU28. In 2015, countries with the lowest mortality (per million) were Sweden (27), the UK (28), Denmark (31), the Netherlands (31) and Malta (26). Those with the weakest road safety records were Bulgaria (98), Romania (95), Latvia (95), Lithuania (83), and Croatia (82). In the EU as a whole in 2015, nearly half of road fatalities (45%) were car occupants; pedestrians contributed the largest share of vulnerable road user deaths (22%) followed by powered two-wheelers (18%) and 8% of all road deaths were cyclists. Most reported deaths in road crashes involve motor vehicles, the majority involving passenger cars.

While important *Policy Orientations* initiatives have been undertaken including the setting of a common definition of serious injury and in-depth study and research, less progress has been made with reducing serious injuries. It is estimated that around 135,000 citizens are seriously injured on European roads using the common serious injury definition. According to national definitions, serious injuries were reduced by just 0.5% since 2010. EU goal and target-setting now needs to include ambitions for the long-term and interim for the prevention and reduction of serious injury.

The socio-economic value of prevention of the death and injury burden is substantial. Road safety research has estimated that this amounts to around 1.8% of the EU GDP for reported crashes increasing to 3% when underreporting is taken into account.[1] Road safety also contributes to the sustained quality and international competitiveness of EU goods and services.

Interventions and institutional delivery: The independent technical assessment in 2015 carried out a detailed, systematic scan of the main road safety measures implemented or foreseen within *Policy Orientations* 2011-2020 as well as those implemented before 2011 and which may now be influencing road safety outcomes to 2020. Assessment of the value of EU road safety strategy in terms of specific impacts requires a range of well-defined, certain, measurable activity and related performance data at all these levels. In the general absence of these, the conclusions and recommendations drawn in this updated assessment remain as before, at best, based on expert judgement.

EU activity before 2011: The most promising EU measures identified as likely to be influencing current road safety outcomes are previous EU legislative initiatives in vehicle design and safety equipment: electronic stability control system in cars and trucks; daytime running lights in all powered two-wheelers, cars and trucks and pedestrian protection. In many cases fitment has started before legislative deadlines, aided by Euro NCAP, industry initiatives and national fast-tracking measures.

Infrastructure safety management of the TEN-T and connecting roads presents an important, ongoing opportunity for better results. An ex-ante impact assessment carried out in 2006 for the road infrastructure safety management Directive 2008/96/EC indicated a potential reduction of around 400 road deaths annually. An ex-post impact assessment indicated much future promise given further developments over time, but no assessment of past safety impact given the lack of safety performance data.

[1] Wijnen, W et al (2017), https://www.safetycube-project.eu/wp-content/uploads/SafetyCube-D3.2-Crash-costs-estimates-for-European-countries.pdf.

Directive 2010/40/EC provided for the mandatory fitment of e-Call which is a system for sending automated emergency calls to the emergency service from vehicles in the event of a crash. The fatality reduction potential was estimated to be between 2% and 10%. The legislation comes into effect for all new car models from April 2018 and may therefore contribute to 2020 outcomes.

EU activity between 2011-2015: The previous assessment noted that the introduction of advanced and anti-lock braking systems in motorcycles coming into force in 2018 was a notable safety development which some Member States fast-tracked nationally. However, in general, the interventions during this period were either insufficiently defined in evolving strategy to allow the estimation of their road safety value or they comprised activity which might lead to the identification of future intervention but without the certainty of implementation. Many actions were noted to be ongoing. The assessment also noted that implementation since 2011 had been understandably variable, given the complexities of road safety at EU level and often dependent on subsequent and, as yet, unknown decisions by Member States. The Cross-Border Enforcement Directive (EU) 2015/413 was one cited example. Furthermore, interventions sometimes insufficiently addressed the largest fatality groups, considered the safe, free movement of people in harmonisation measures or paid enough attention to the evidence base. While a range of valuable preparation had been carried out and important steps taken, the most promising aspects of *Policy Orientations* intervention during this period, whether in implementing proven vehicle safety technologies, further developing infrastructure safety or ensuring safety-sensitive powered two-wheeler rider and car driver licensing schemes, had yet to be adopted and implemented.

EU activity 2015-2017: Since 2015 a range of activities comprised impact assessments on previously implemented legislation (cross border enforcement) and proposals for revisions of legislation (road infrastructure safety management; vehicle general safety regulation and pedestrian safety regulation; training for professional drivers and rest times for truck drivers). The impact assessment on cross border enforcement found that the new EU rules had had a positive impact in reducing road traffic offences while abroad. While no estimate was given of the direct impact on casualty reduction, further improvements were suggested. New proposals for road infrastructure safety management and improvements in vehicle safety, if adopted and implemented are likely to lead to very substantial savings in deaths and serious injuries over time.

Overall assessment of Policy Orientations*:* The 2015 study supporting the Commission's interim evaluation of the current strategy, as does this updated assessment, found considerable scope for the further development of EU road safety goals, targets and evidence-based strategy. There remains a large gap between current results and the rate of progress desired by all the EU institutions to address preventable and unacceptable death and serious injury resulting from road collisions. EU action requires relatively long lead times. Whereas key actions taken in the previous decade will now be contributing to the 2020 target, few actions taken since 2011 are unlikely to have made a major contribution yet. While valuable preparation has been carried out and important steps taken, the most promising legislative aspects of *Policy Orientations* intervention, particularly in the vehicle safety field where the EU can act most efficiently, have yet to be adopted and implemented.

Future progress will depend upon a sharpening of focus on death and serious injury prevention and mitigation, an inclusive delivery framework and a broadening of scope to align with other societal objectives to scale-up capacity and investment in road

safety. In addition, future strategy will need to consider a range of external factors and emerging social and mobility trends which are likely to influence future results.

FUTURE PROSPECTS

Emerging social and mobility trends: A range of external factors and societal trends increase the road safety challenge to 2030 and beyond. The most notable are the continuing increases in GDP as economies continue to recover from the global financial crisis; the ageing road user population and its physical vulnerabilities; more travel by unprotected modes of walking and cycling vulnerable to death and serious injury risk; continuing popularity of the highest risk powered two-wheeler mode; the electrification of bicycles allowing higher speeds; and increased access to mobile, smart communication and information technologies in vehicles. While connected and autonomous vehicles are coming, a safe path forward is not yet assured.

Increasing ambition for better road safety results: At the same time, a heightened ambition for better road safety results has been expressed by the EU institutions. In the Valletta Declaration in March 2017, EU Transport Ministers called for further target-setting to 2030 within the framework of a new road safety strategy. The European Parliament has consistently supported the Commission's Vision Zero ambition and has also called for further target-setting to 2030. High Level Group Road Safety meetings and stakeholder meetings continue to strongly support more ambitious activity. Ambitious goals and targets require a stronger, planned, systematic road safety approach at EU, national and local levels.

Increasing adoption of the Safe System approach: The adoption of the internationally recommended and increasingly implemented Safe System strategy across EU countries is needed to realise ambitious results and provide focus for professional effort. A range of EU activity is needed including the setting of a new safety performance framework comprising long-term goals for the ultimate prevention of death and serious injury, supported by interim targets and a range of key safety performance indicators against which progress can be targeted and monitored. The setting of indicators representing the underlying operational conditions underpinning fatal and serious injury prevention will enable closer and more focused safety management by different levels of government and encourage multi-sectoral activity along demonstrably effective lines.

Increasing the scope of institutional delivery: There is increasing acknowledgement in road safety that the scope and quality of institutional delivery provides the foundation for systematic intervention and better results. The Commission will need to review its capacity and the technical support needed to fully implement a Safe System approach towards zero deaths and serious injuries. The willingness of its partners for shared responsibility will also need to be explored. More use might be made of EU funding mechanisms for road safety infrastructure investment, demonstration projects and guidance on implementation.

Aligning with other societal objectives: Coordination with a range of sectors is needed to explore how further advocacy efforts, budgets and interventions undertaken by these can expand the scope and capacity of road safety management. Road safety needs to be aligned with *public health, rights of the child and citizens, sustainable transport goals*, especially those relating to the *environment* and *liveable cities.* Road safety can also be aligned with *tourism goals* since the risks of road traffic injuries are appreciably higher for tourists than many other health risks, *regional and neighbourhood policies and* to *poverty reduction* and *international developmen*t goals. Road safety needs to be at the heart of *occupational health and safety objectives* since

road traffic injury is a leading contr*ibu*t*or* to *w*ork-rel*a*ted death. Not least, activity to address death and serious injury in road traffic is inter-linked to *economic objectives*, given the substantial value of prevention of the death and injury burden, estimated at around 3% of EU GDP.

CORE RECOMMENDATIONS FOR EU ROAD SAFETY STRATEGY 2020-2030

This study sets out proposals for the development of a new EU road safety strategy around a core road safety performance framework. It makes recommendations for results-focused EU and national action. The key core actions at EU level include:

Leadership:

- Continue to provide road safety leadership at the highest level and adopt a Safe System approach within a new Towards Zero road safety strategy 2020-2030.
- Review the Commission's road safety management capacity.
- Consider establishing a European Road Safety Agency as an executive arm.
- Set up a new Commission inter-directorate coordination group in support of the new road safety strategy and its goals, targets and objectives; strengthen High Level Group and working group activity; set up Safe City initiatives; engage with the EU's leading employers on road safety results and engage with key stakeholders at EU level to encourage contribution to a range of measurable performance objectives, reporting in Annual Results Conferences.
- Set up new funding mechanisms and processes to scale up road safety investment.

Goals:

- Extend the scope of the current long-term goal to include a separate long-term goal for serious injury to move close to zero fatalities and zero serious injuries in road collisions by 2050.

Targets:

- Set new interim targets to reduce the number of a) deaths and b) serious injuries by 50% by 2030 (2020 baseline).

Key performance objectives:

  - Establish the following key safety performance fields as the core of new strategy supported by specific, measurable key performance indicators:
  - Increasing the safety quality of roads and roadsides
  - Improving levels of safe travel speeds
  - Increasing the safety quality of new vehicles
  - Increasing the efficiency and effectiveness of post-crash care
  - Increasing levels of safe road use (use of seat belts, child restraints, crash helmets; driving without alcohol or other drugs); driving without distraction.
- Set a minimum set of recommended key safety performance indicators within these fields which are directly related to the prevention and mitigation of road death and serious injury to provide focus for intervention strategy and institutional delivery. Work with Member States to target progress to 2030.
- Set out options for each indicator EU and national intervention and related institutional delivery e.g. funding, monitoring and evaluation, research and development, knowledge transfer. This study has proposed 10 indicators which, if addressed fully, have an estimated potential (where estimates have

been possible) to save over 12400 lives and prevent over 37900 serious injuries in EU countries by 2030.

Key road safety performance indicators (KPIs)	
1	Proportion of traffic volume on the comprehensive TEN-T network and other roads of strategic importance with a 3-star or better Euro RAP rating
2	Proportion of traffic volume with drivers travelling within the speed limit on urban roads, rural roads, motorways, TEN-T network.
3	Proportion of traffic volume on urban, rural, motorways, TEN-T roads within speed limits which are 'safe and credible'.
4	Proportion of new passenger cars with a 5-star Euro NCAP rating.
5	Proportion of seriously injured road crash victims with access to professional medical assistance within 15 minutes of notification.
6	Proportion of motor vehicle occupants using a seat belt in a) front seats and b) rear seats
7	Proportion of correct use of child restraints by child occupants
8	Proportion of a) motorcyclists, b) moped users and c) pedal cyclists with correct use of a protective helmet.
9	Proportion of drivers and riders of motorised vehicles without alcohol or other drugs which impair driving.
10	Proportion of drivers without use of in-car telephones.

Further preparatory work for strategy development

In planning to launch the new strategy in 2018, the European Commission has taken into account the need for further preparation of elements of the strategy to allow the start of implementation in 2020. The following activities to be carried out between now and 2020 are recommended:

- Project activity to prepare the further definition and measurement of new EU key safety performance indicators, measurement protocols and possible targets 2020-2030 (to be announced in 2020).
- Project activity to identify specific targeted, cost-effective EU investment in road safety especially in needy areas where there is specific EU competence. within a new Safer Roads Fund or other financial incentive scheme.
- Project activity to review readiness for action for new shared responsibility for road safety and to establish co-benefits with other societal objectives e.g. transport, health, occupational health and safety, industry, environment; identify possible new strategic functions for the High-Level Group on Road Safety and engagement of key stakeholders at EU level who can contribute to a range of measurable performance objectives and reporting in Annual Results Conferences on their contributions.

1 Introduction

In 2010, the European Commission introduced the current road safety strategy - *Policy Orientations on Road Safety 2011-2020.*[2] This document sets out an ambitious quantitative target to reduce the number of annual road deaths by 50% between 2010 and 2020. The following year, and in addition to the 2020 target, a Transport White Paper set out a highly ambitious long-term goal of virtually eliminating road deaths by 2050 – a *Vision Zero* for EU road safety activity.[3] It also envisaged the setting of a quantitative target to reduce road injuries. In a series of seven broad strategic objectives, *Policy Orientations* set out a range of policy priorities, intervention fields and policy instruments to provide a framework for activity towards the 2020 target. In 2015, the Commission carried out an interim evaluation of progress to date supported by an independent evaluation.[4] [5]

The European Commission is now embarking on work to take stock of activity to date and to prepare the way for a new road safety strategy for the period 2020 to 2030 towards zero deaths by 2050 for the longer term. It is envisaged that this would include adoption of the Safe System approach and the setting of new goals, targets and objectives. This study comprises preparatory work to assist the European Commission with the development of a new EU road safety framework for the period 2020 to 2030.

1.1 Objectives, outline of tasks, approach and methodology

This section presents the objectives, tasks to be addressed and general approach in this preparatory work to address to the Commission's specification in MOVE/C2/2017-87.

Objectives

The Commission set three objectives to be addressed in the task:

- assess the outcome of the road safety policy framework until the end of 2017, building on the interim evaluation carried out in 2015;
- consider current and future changes in mobility and its consequences and challenges in relation to road safety;
- assist in the preparation of the EU road safety framework for 2020-2030.

Tasks

The specific tasks to be carried out in support of these objectives are:

- the collection of data on road safety statistics and trends;
- analysis of the state of play of road safety in the EU and future prospects;
- consultation with experts and stakeholders;
- analysis and recommendations for an EU road safety framework for the period 2020-2030.

[2] European Commission (2010). Towards a European road safety area: Policy Orientations on Road Safety 2011-2020, Brussels, 20.7.2010 COM (2010) 389 final.

[3] European Commission (2011). White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system COM(2011) 144 final, Brussels, 28.3.2011.

[4] European Commission (2015). DG MOVE Unit C4: Road safety. Interim evaluation of the Policy orientations on road safety 2011-2020, Brussels.

[5] Breen J (2015). Road safety study for the interim evaluation of Policy Orientations on Road Safety 2011-2020, February 2015, Brussels.

Study team

The preparatory work has been carried out by Jeanne Breen in the role of Project Manager and road safety expert, assisted by four road safety experts in a sub-contractor role - Dr Henk Stipdonk, Dr Frits Bijleveld and Drs Niels Bos from SWOV, who carried out most of the quantitative work for the study, and Professor Pete Thomas of the Design School at Loughborough University.

General approach

The general approach/reference point of Jeanne Breen Consulting is based on an understanding of and practical experience of utilising internationally recognised good practice road safety management principles:

- the importance of a focus on results, both final outcomes (deaths and serious injuries) and intermediate outcomes, setting values for the longer term as well as setting targets for the interim within a specified time period in accordance with established good practice;

- the importance of adherence to a Safe System approach to evidence-based, cost-effective, multi-sectoral intervention which better accommodates human error and human tolerance to injury, particularly for vulnerable road users;

- the importance of institutional management arrangements to facilitate and provide a foundation for delivery of results-focused action and rapid knowledge transfer, not least in those countries of the European region which are motorising rapidly and where road safety outcomes need to be brought under control with some urgency and on a sustainable basis.

In addition, this task is informed by Jeanne Breen and the team's understanding and practical experience concerning EU road safety Treaty obligations, the Acquis and the EU road safety role, the opportunities and barriers as well as the complex multi-sectoral context in which institutional delivery is carried out.

Approach to specific tasks

The wide variety of inter-related tasks for the preparatory work has involved a range of methodologies which are outlined below:

Tasks 1 and 2: Data collection and analysis of the state of play in road safety in the EU and future prospects

The Commission's interim evaluation supported by an independent study provided comprehensive assessment of the state of play in road safety between 2011 and 2015. The independent study contributing to the Commission's interim evaluation carried out a substantial review of the different elements of Policy Evaluations. It focused on the contribution of EU activity to the strategy, as a comprehensive analysis of activity within individual Member States was, as now, outside the scope of the small study. The findings have been updated within this task.

While supported by this quantitative data, the further assessment of the policy framework, as in the previous assessment is a largely qualitative assessment and based on best expert judgement. As stated in the previous independent review, purely quantitative or empirical assessment of past activity in the framework of Policy Orientations is not possible for a variety of reasons which include:

- Policy Orientations is a high-level strategic document, as opposed to an action plan which sets out specific activities which are not generally amenable to evaluation.

- The target of Policy Orientations is aspirational rather than empirical in nature.
- Most safety problems addressed by Policy Orientations are not measured and the EU performance indicators set for the strategy are very limited.
- Reliable exposure data information such as the amount of travel is not available for all Member States, for all road types and road use types.
- Detailed assessment within the scope of this study is not possible of implementation activity in all Member States, in all sectors and agencies of the European Commission and by others.

As in the previous independent study, the overarching systematic approach adopted for these tasks is based on an established and widely used road safety management capacity review framework.[6] This comprises a strategic scan and qualitative assessment of *interventions*, and *institutional delivery* aspects relating to Policy Orientations since 2015. A quantitative presentation of *results* since 2000 and for the strategy period 2011-2017 is provided, with reference to a wide range of exposure, final and intermediate outcome data as well as consideration of future prospects.

Results, interventions and institutional delivery

Working with DG MOVE services, available road safety statistics and time-series trends on deaths and serious injuries from the CARE database have been collated for assessment of *results*. The objective has been to update information provided in the 2015 interim evaluations wherever possible and include discussion of potentially influential factors which may affect future trends to 2030. The primary source of data has been the CARE database, complemented as needed with additional data as necessary and available. This has included data from the annual IRTAD reports and database, the ETSC PIN surveys, Euro RAP and Euro NCAP information and data from a range of EU projects and from national databases.

This task also involves consideration of current and future changes in mobility and its consequences and challenges in relation to road safety. Road safety activity does not occur in a vacuum and is influenced by developing economic trends, social and demographic trends, mobility patterns and developments in new technologies. Account needs to be taken of all these factors in considering future road safety action to 2030 and beyond. A range of data and research information has been collected to provide information on a range of external factors, societal and mobility trends. These include available traffic volume data, demographic trend data including an ageing road user population, unemployment trends and economic trends which can influence safety outcomes. In addition, data on mobility patterns and emerging trends in urban mobility and modal choice is presented as well as information on connected and autonomous vehicle development. All these are likely to influence road safety results over the next decade and the challenges and opportunities which they present are discussed.

A major part of the task has also been a review of intermediate outcome data/safety performance indicators. Existing good practice in the use of road safety performance indicators as a means to evaluate and define policy and target specific progress has been reviewed. Here, the aim has been to identify options for key performance indicators which could be used in the new 2020-2030 road safety strategy. Special attention has been given in identifying the risk relationships between different indicators and serious and fatal crash and injury causation. The main body of this analysis – methodology and base data - is presented in Annex 2. Specific

[6] Global Road Safety Facility (GRSF) (2009), Bliss T and Breen J. Implementing the Recommendations of the World Report on Road Traffic Injury Prevention. Country guidelines for the Conduct of Road Safety Management Capacity Reviews and the Specification of Lead Agency Reforms, Investment Strategies and Safe System Projects, World Bank, Washington DC.

recommendations are presented on a priority set of safety performance indicators which relate to the prevention and mitigation of death and serious injury in road collisions for the next EU road safety strategy (Section 4). Rough estimates have been made about the potential contribution of these indicators, if adopted and implemented, to reducing death and serious injuries to 2030.

Other sources of data have also included a variety of institutional output data for example on road and vehicle engineering and police enforcement activity.

Working with DG MOVE services, information on *interventions* and *institutional delivery* since 2015 has been collated and conclusions from the previous assessment to 2015 have been reviewed and updated.

The combination of these approaches and activities provides an analysis of the current state of play of road safety at EU level which allow conclusions to be drawn about progress to date with Policy Orientations and to inform the challenges and opportunities ahead for next EU road safety steps to 2030.

Task 3: Consultation with experts and stakeholders

Three members of the study team have engaged with a range of EU experts in two meetings organised by the European Commission on key safety performance indicators (KPIs). Results of these discussions have informed the KPI work in the previous tasks and in Task 4.

A further task has been to provide assistance to the Commission with activity related to the preparation of a stakeholder consultation workshop held on 22nd January 2018 in Florence, hosted by the European Commission. A paper on key themes was provided which contributed to the Commission's background document which was circulated. The consultant also contributed to the agenda preparation, attended the workshop and contributed an overview and background presentation which introduced the key workshop themes. The outcomes of these discussions will inform consideration of the next road safety strategy and the proposals identified in Task 4.

Assistance has also been provided to the Commission for preparatory work towards the High-Level Group on Road Safety[7] meeting on 8th February 2018.

Task 4: Analysis and recommendations for an EU road safety framework: 2020-2030

Following a synthesis of information from earlier tasks, Task 4 involves providing a set of well-argued policy recommendations to the Commission concerning the scope, content and structure a road safety framework for the period 2020-2030. Recommendations for further preparatory work are made.

Running through this discussion is the implementation of the internationally recommended Safe System approach to underpin a new strategic framework. In relation to EU action, the study has taken into account the convenience, feasibility and practical aspects of implementing Safe System in the EU and discusses the best tools to monitor road safety progress. It has also sought to identify any problem areas in defining or implementing the most effective measures.

[7] Set up following the request of the Council in Council Resolution of the Council and of the representatives of the governments of the Member States meeting within the Council of 21 June 1991 on a Community programme of action on road safety (91/C 178/01).

The recommendations address the good practice elements of road safety management of *results* (expressed as goals and targets) and set out a proposal for a new road safety performance framework to form the core of EU road safety strategy. This will address system-wide *interventions* which are directly related to the prevention and mitigation of fatal and serious injury. Recommendations covering *institutional management* address EU action in the field of road safety, and the responsibilities of national, local and regional authorities as well as other stakeholders.

1.2 Report structure

Following an Executive Summary and introduction, the assessment starts with an outline of the context for EU road safety work including key EU Treaty obligations and the principles underlying the current *Policy Orientations* road safety strategy; external factors and emerging social and mobility trends and the trend towards achieving more ambitious road safety results (Section 2). Section 3 comprises a status report on current road safety performance and future prospects. It updates assessments on progress with *Policy Orientations* against expected outcomes and outlines the challenges and opportunities for future activity. On the basis of the work carried out and taking into consideration a wide range of reference material, Section 4 outlines recommendations for a new EU road safety strategy. The report is supplemented by Annexes comprising additional statistical tables and other information. These documents are appended separately. A stand-alone Executive Summary accompanies the documents.

2 The context for road safety in the EU

2.1 The EU role

The European Union has broad shared competence in a variety of areas relevant to road safety, as set out in Article 4 of the Treaty of the European Union. In common with other areas of shared activity, road safety competence is governed by the principles of subsidiarity and proportionality.

The Treaty on the functioning of the European Union sets out the specific shared responsibility of the EU with its Member States for measures to improve transport safety in Article 91c.[8] In addition, the Treaty stipulates that all Single Market harmonisation concerning health, safety, environmental protection and consumer protection shall take as a base a high level of protection (Article 114(3))which is especially important in vehicle standardisation.

While the provisions for the Common Transport Policy and the Single Market create the framework for key legislative activity relating to road safety, the Treaty on the functioning of the European Union also sets out competences in many sectors, most notably in public health and occupational health and safety.[8] A high level of human health protection is to be ensured in the definition and implementation of all Union policies and activities (Article 168). In public health, the EU may also adopt incentive measures designed to protect and improve human health and, in particular, to combat the major cross-border health scourges (Article 168(5)) of which road death and

[8] Council of the European Union, 12 November 2012. 6655/7/08 Rev 7, Consolidated version of the Treaty on the functioning of the European Union, Brussels.

serious injury is a prime example. In social policy, the Treaty states that the Commission shall encourage cooperation between the Member States and facilitate the coordination of their action in a range of fields, including the prevention of occupational accidents and diseases (Article 156). Other shared competences exist in relation to neighbourhood policy and international development.

Against this background, the current road safety strategy document *Policy Orientations* (2011-2020) set out three main principles for road safety action:

- *an integrated approach to road safety* where future road safety policy is taken into account in other policy fields of the EU and takes the objectives of these other policies into account;
- *striving for the highest road safety standards* throughout Europe raising the level of road safety, ensuring safe and clean mobility for citizens everywhere in Europe and fostering equity among road users through focused efforts to improve the safety of more vulnerable road users; and
- *subsidiarity, proportionality and shared responsibility*.[9]

Box 1: The road safety role of the European Union

The EU can add value to Member States' road safety efforts by:

- Establishing through 2050 goals and the setting of interim targets and objectives to 2030 a focus on achieving ambitious road safety results across the EU, supported by governmental leadership, an EU Towards Zero road safety strategy around core performance objectives, aligning at the same time with a broad range of related societal objectives.
- Coordinating actions across Commission Directorates at EU level, with other EU institutions in a coordination body, with Member States through the High-Level Group on Road Safety and CARE groups and with the business sector and civil society to achieve desired results.
- Legislating to meet the road safety task in areas of shared competence with due consideration to subsidiarity, proportionality, the evidence-base and the need to provide a high level of protection.
- Funding initiatives supporting EU goals, targets and action programmes on the TEN-T and other roads, twinning and capacity building initiatives and projects, research and development, benchmarking review, data collection funds, best practice guidelines, effective NGO activity.
- Promoting the societal shared responsibility for road safety at a high level and creating new demand for road safety.
- Monitoring and evaluation of road traffic crashes, injuries and exposure to risk in transport and health sectors, EU action programmes, objectives and interventions through CARE, other databases, surveys and projects, in-depth study and independent review.
- Research and development of road safety interventions and tools to implement Safe System; disseminating knowledge following EU projects such as Safety Cube; developing best practice guidance and funding the European Road Safety Observatory.

In summary, the competences outlined above provide a substantial basis for a wide range of related road safety activities and opportunities for a broad EU road safety role

[9] European Commission (2010). Towards a European road safety area: Policy Orientations on Road Safety *2011-2020,* Brussels, 20.7.2010 COM (2010) 389 final.

and alignment with other key societal objectives as set out in Box 1. At the same time, the broad multi-sectoral context for road safety presents both challenges and opportunities for road safety which require careful management and leadership.

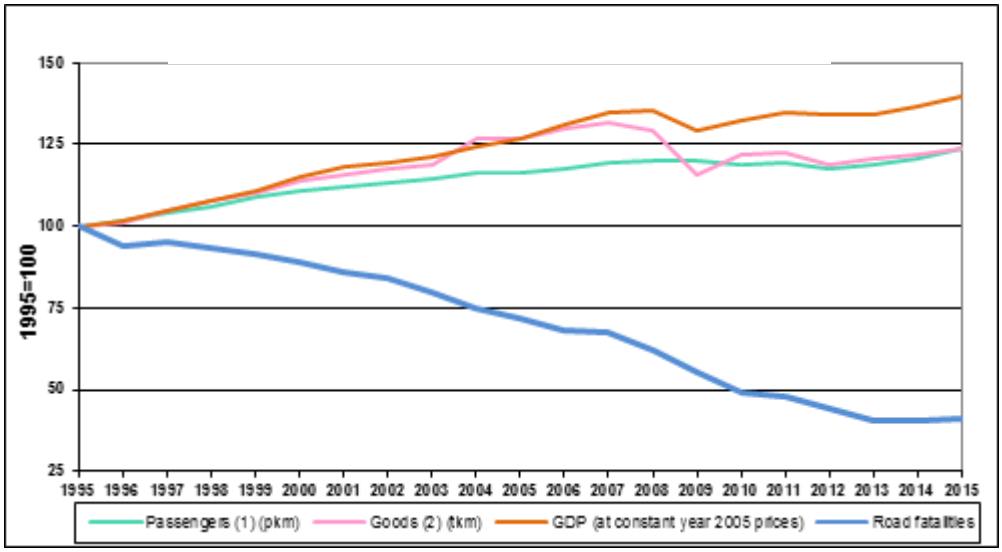
2.2 External factors and emerging social and mobility trends

External factors outside of road safety management create an ever-changing context for road safety activity. In addition to the quality and quantity of interventions and institutional delivery, road safety results are influenced by economic trends, social and demographic trends and changing mobility patterns. Fundamental developments in new technologies towards digitisation, decarbonisation and automation will have increasing impact on everyday travel and road safety needs. Account needs to be taken of all these factors in assessing past performance and in considering future road safety action to 2030 and beyond.

2.2.1 Economic trends and the amount of travel

Research by the OECD provides evidence that when economic growth declines, and particularly when unemployment increases, road safety improves. In times of economic upturn, a reverse effect is evident unless new and adequate measures are applied. The financial crisis of 2007-2008 and the subsequent severe economic downturn have been accompanied by marked falls in annual numbers of road deaths in most OECD and EU countries with larger falls than countries had become accustomed to previously. This has influenced the number of road deaths through a reduction in vehicle kilometres driven, especially by young men and by heavy goods vehicles, a reduction in speeding and in drink-driving, and a reduction in learning to drive by young men.[10] Since the sharpest downturn in 2009, levels of GDP and goods traffic have been on the increase in the EU, as shown in Figure 1.

Figure 1: EU passengers, goods, GDP, road fatality trend 1995-2015



Source: European Commission (2017). Statistical Pocketbook Transport in Figures, Chapter 2.1, tab: growth_eu28 : https://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2017_en

[10] OECD/ITF (2015). Why Does Road Safety Improve When Economic Times Are Hard? Report by IRTAD, OECD Publishing, Paris.

For the EU 28, sharp declines in road deaths between 2007 and 2010 (particularly for the <24 years age group) coincided with a marked decline in GDP growth. Unemployment levels for EU 28, particularly for young people rose sharply. A steeper downward trend in HGV traffic and HGV-involved road deaths compared with total traffic and all deaths also took place during 2007 and 2009.

Whilst research indicates that economic recession worked positively for road safety in the EU 2007 and 2009, the recent stronger economic development, compared with the lowest levels of GDP experienced is likely to be a key factor in slowing road safety progress. The amount of travel is strongly related to levels of GDP and road deaths. The implications of continuing growth in EU GDP to 2030, estimated at an annual level of 1.5% [11] need to be taken into account in developing road safety strategy. The absence of EU 28 information traffic volume for all road types and user types impedes analysis and needs to be addressed.

2.2.2 An ageing population

Important demographic factors in relation to fatal injuries concern the share of the total population of young people (who are at disproportionately high risk of serious and fatal crash involvement due to inexperience and other factors) and older users (who are at disproportionately high risk of serious and fatal crash injury due to physical vulnerabilities).

Eurostat population statistics (2017) indicate a declining share for those in the 15-24 age group but a rising share for older people as a greater proportion of the post-war baby-boom generation reaches retirement and with better life expectancy. Life expectancy has continued to rise in all of the EU Member States in recent decades. The numbers of citizens aged 65 and over are increasing annually and comprised around 19% of the population in 2016. A particularly rapid increase in the number of very old persons (aged 85 and over) is foreseen in population projections.[12]

The proportion of people aged 65 years and over who are at disproportionately high risk of serious and fatal crash injury due to physical vulnerabilities is expected to rise to 24% by 2030. With an average age of 44 years, Europe will be the 'oldest' region by 2030. The protective needs of the older road user group need to be taken into account in developing road safety strategy. The road traffic system needs to be adapted to support safe, increased mobility for an ageing society.

2.2.3 New urban mobility patterns

Non-motorised travel plays a key role in sustainable mobility and is expected to increase alongside the trend in greater urbanisation. Too little information is available to quantify the current and forecast future active travel by walking and cycling in EU countries and there is likely to be a mixed picture of the amount of travel in these modes in different Member States.

The need for greater equity in urban transport modal share is being acknowledged and encouraged at policy level in urban transport policies, sustainable city development (e.g. Amsterdam, Barcelona, Copenhagen, Milan, Munich, London and Vienna) and walking and cycling strategies at EU, national and city levels.[13] [14] Walking and cycling

[11] ESPAS (2012). The Global Economy in 2030: Trends and Strategies for Europe. ISBN:978-92-79-29721-2 /
[12] Eurostat (2017). Population structure and ageing, Brussels.
[13] COM (2013) 913 final Communication: Together towards competitive and resource-efficient urban mobility, Brussels, 17.12.2013.
[14] Commission Staff Working Document, *Targeted action on urban road safety* Brussels, 17.12.2013.

neither takes up as much space as private cars nor contributes to emissions which pollute the environment and endanger public health. The health benefits of walking and cycling activity in reducing the risks associated with obesity are increasingly realised.

However, walking and cycling will have an adverse impact on road safety outcomes unless urgent steps are taken to take better account in road traffic system planning and design of the physical vulnerabilities of users of these modes. While having a lower modal share, unprotected pedestrians and cyclists have a much higher risk of death and serious injury than protected users in vehicles. This can be addressed by physically separating these users from motorised traffic on roads which require speeds above 30 km/h, by protecting them in mixed traffic by lowering motor vehicle speeds to, at most, 30 km/h as a priority on residential roads and roads where pedestrian and cyclists volumes are high and ensuring that speeds do not exceed the protective qualities of roads and vehicles.[15] Recent EU comparisons in risk are not available. In the UK, cyclists and pedestrians have 15 and 16 times the fatality risk of car users respectively.[16] In the Netherlands, this ratio is less than a factor of 10.[17] This raises important issues both for road safety and in the promotion of active travel where the actual risk of death and serious injury is sometimes downplayed for fear of increasing perceived risk which might discourage take up of these modes. Allowing premature death before overall, long-term health benefits can be realised raises important ethical issues for policymakers and practitioners, especially as they relate to children. Safe environments are needed with separated facilities, footpaths and cycle paths; safe layouts with lower speeds which minimise conflicts between traffic and cyclists or pedestrians; better vehicle design and safety equipment to reduce the risks of dangerous mixed use and attention to the safety quality of footpaths to prevent injury from falls, particularly amongst elderly pedestrians.

2.2.4 Continuing popularity of powered two wheelers

The popularity of powered two wheelers continues, evidenced by the new vehicle stock of powered two-wheelers registered in the EU which has increased by 34% since 2000.

However, the risk (road deaths per distance travelled) for motorcyclists in Britain is 52 times that of car users.[16] In the Netherlands this risk ratio is approximately 40.[17] Urgent action is needed to address the continuing high level of risk faced by this road user group. A focus on implementing evidence-based measures to address the exceptionally high risks of this road user group is required.

2.2.5 Cooperative, connected and automated vehicles

As GEAR 2030 noted, the advent of cooperative, connected and automated vehicles can be expected to significantly change the face of the automotive sector and vehicle use. Increasing automation and the exchange of data between vehicles (V2V),

SWD (2013) 525 final.

[15] OECD/International Transport Forum (2016), Zero Road Deaths and Serious Injuries: Leading a paradigm shift to a Safe System OECD Publishing, Paris.

[16] Department for Transport (2016) Reported road casualties in Great Britain 2016: Chart 2: Casualty and Fatality rates per billion passenger miles by road user type: GB 2016

[17] Based on road death data tables from statistics Netherlands, and mobility data from KiM (Dutch Ministry of Transport, 2016).

between vehicles and the traffic infrastructure (V2I) and the connection of vehicles to the internet are developments with far reaching consequences on travel patterns.[18]

Different levels of automation have been defined by the Society of Automotive Engineers (SAE) to simplify communication and facilitate collaboration within technical and policy domains. The taxonomy of six levels of driving automation in an SAE standard span from no automation to full automation is being used internationally to explain the technological development path. The levels and their names are summarised below and explained in Annex 1.[19]

Table 1: Outline of SAE levels of automation

Automation level	Description
Level 0	No automation
Level 1	Driver assistance
Level 2	Partial automation
Level 3	Conditional automation
Level 4	High automation
Level 5	Full automation

A key distinction is made by the SAE between Level 2, where the human driver performs part of the dynamic driving task, and Level 3, where the automated driving system can perform the entire dynamic driving task.

A recent report for the European Parliament notes that a variety of driving assistance systems of Level 0 (no automation), Level 1 (driver assistance) and a smaller number of Level 2 (partial automation) technologies are currently available on the market, mainly implemented on passenger cars to support driving on motorways or for parking.[20] The report notes that vehicle manufacturers are investing in the research and development of more advanced automation systems up to Level 3 (conditional automation) and research and testing of higher automated systems (level 4 – high automation and level 5 – full automation) is already underway.

Forecasts have been made on the exact length of the path to full automation. The study conducted for the European Parliament states that the broad view is that increasingly automated systems (Levels 2 to 4) are likely to be introduced in the short (next 5-10 years) and medium term (10-20 years), while full automation is expected to be feasible on a large scale in a farther time horizon (more than 20 years), but not necessarily universally implemented.[20] The latter levels require more advanced technological systems, as well as greater modification to the current international and national regulatory frameworks and available infrastructure. Truck platooning is expected to follow an incremental pathway consisting in the progressive reduction of the responsibilities of the drivers until full replacement would ultimately occur. On the other hand, urban mobility and public transport is expected to follow a different pathway towards full automation – i.e. the 'everything somewhere' approach, consisting in the development of highly automated vehicles initially circulating in specific restricted environments and then gradually rolled out. Highways England, the national highway authority for the strategic road network (SRN) has estimated that

[18] DG GROW – Internal Market, Industry, Entrepreneurship and SMEs (2017) GEAR 2030, Final Report – 2017, High Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union, Brussels.

[19] Society of Automotive Engineers (2014) J3016.http://www.sae.org/misc/pdfs/automated_driving.pdf

[20] European Parliament Directorate General for Internal Policies (2016). Research for the TRAN Committee. Self-piloted cars: the future of road transport? Brussels.

the timescale for connected and fully autonomous vehicles on the SRN, the most amenable of road types to developing connectivity and automation, is as follows:

- In 10-15 years, most vehicles will have connected capability
- By 2040, most vehicles will be connected to infrastructure
- By 2050, full automation can be expected on the strategic road network.[21]

The High-Level Group concluded that to 2030 full automation will likely remain confined to niches and it will be a period of learning rather than transformation.[22]

Forecasts thus indicate that there will be a long transition phase to full automation as more, increasingly autonomous vehicles are introduced to the vehicle fleet in EU Member States. Driverless and connected vehicles – more than 30 years away - will need close management and regulation. For many years there will be a mix of highly automated and non-automated vehicles in traffic. Without large scale trials of autonomous systems, it is not known how this will affect road safety overall. For example, a system that automatically limits speed to the speed limit is highly likely to produce benefits once a threshold penetration has been reached. On the other hand, pedestrians and other vulnerable road users may have expectations of vehicle functionality that are not there and may take new risks. Furthermore, there is the possibility of technical failure or design failure and problems with interaction between vehicles with different technical systems and so on.

While there is a general expectation that road safety may improve through better connected and autonomous vehicles, effective safety performance of automated systems has yet to be demonstrated. Several technical challenges still need to be addressed and little information is available on the potential emergence of new risks. The extent to which automated systems could contribute to improve safety will also depend on their rate of market penetration – which is likely to be a relatively long process.[20] A 2030 strategy should acknowledge that 1) we cannot wait for full automation to address road safety needs; 2) that a range of demonstrably effective safety technologies to earlier levels require urgent implementation and 3) that in addition to continuing research and development, an EU policy and regulatory framework for connected and autonomous vehicles is now required to ensure a safe path forward.

2.2.6 Electro-mobility

The commitment and growth and to electric mobility addresses the EU goal that by 2050 at the latest, greenhouse gas emissions from the transport sector must be reduced by at least 60% compared with 1990 levels.[23] With several Member States and car manufacturers announcing the end to vehicles powered by diesel and petrol the car fleet is likely to continue a shift towards electric mobility. In addition, new types of small city vehicles are being introduced.

Various types of two-wheeled vehicles have been electrified in recent years. Electric bikes known as Pedelecs have increased in popularity in some European countries and use is expected to increase further especially for longer journeys and by older riders. These are bicycles where the cyclist's pedalling power is supported by a battery-powered electric motor, primarily designed to aid the rider when starting off or when

[21] Highways England (2017). Connecting the Country, December 2017.

[22] DG GROW – Internal Market, Industry, Entrepreneurship and SMEs (2017) GEAR 2030, Final Report – 2017, High Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union, Brussels.

[23] European Commission (2011). *White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system* COM(2011) 144 final, Brussels, 28.3.2011.

cycling uphill. Other types of e-Bike include the more powerful Speed Pedelecs (S-Pedelecs) and power-on-demand e-Bikes (in which motors can provide assistance regardless of whether the rider is pedalling or not) as well as quadricycles and unicycles, using public roads. In addition, the numbers of electric scooters have also increased, and the electrification of motorbikes has commenced.[24]

It is noted that electrically powered vehicles may have higher acceleration levels than traditionally powered vehicles. The potentially higher speeds that Pedelecs and other e-bikes can achieve will have road safety consequences and their use needs urgent review as well as safety regulation in terms of the use of protective helmets.

2.2.7 Mobile communication technologies

Over the last decade, substantial increases have been reported on the availability and use of a range of mobile technologies. These include smartphones and tablets as well as handheld or wearable devices for communication and information.[24]

The potential amount of distraction associated with increasing use of in-vehicle internet and email access systems while driving is highlighted widely in the literature.[25] Increasing use of such portable mobile devices while driving can only increase the number of distraction-related crash outcomes. The human-machine interface of in-car information systems and telephones need to be designed as ergonomically as possible to allow safe use such as automatic postponement of the connection of incoming calls and designing complex human-machine interfaces that would regulate driver use of in-vehicle systems.

Conclusions

A range of external factors and societal trends increase the road safety challenge to 2030 and beyond. The most notable are the continuing increases in GDP as economies continue to recover from the global financial crisis; the ageing road user population and its physical vulnerabilities; more travel by unprotected modes of walking and cycling vulnerable to death and serious injury risk; continuing popularity of the highest risk powered two-wheeler mode; the electrification of bicycles allowing higher speed and the increased access to mobile, smart communication and information technologies within vehicles. While connected and autonomous vehicles are coming, a safe path forward is not yet assured. Full account needs to be taken of these challenging developments within the developing road safety strategy.

2.3 Increasing ambition for better road safety results

2.3.1 The global context

A further development over the last decade has been the global and regional commitment to achieving better road safety results. In December 2015, new Sustainable Development Goals were agreed in the World Assembly.[26] Ambitious new road safety goals and targets were formally set for the first time (see Box 2) and opportunities presented for road safety to align with a broad range of other SDGs.

[24] European Parliament Directorate General for Internal Policies (2016). Research for the TRAN Committee-The World is Changing Too.

[25] European Commission, Cell Phone Use While Driving, European Commission, Directorate General for Transport, September 2015.

[26] Resolution 70/1 adopted by the General Assembly on 25 September 2015. Transforming our world: the 2030 Agenda for Sustainable Development, UN, Geneva.

Box 2: Sustainable Development Goals and Road Safety

SDG 3.6	Halve road deaths and injuries by 2020.
SDG 11	Make cities and human settlements inclusive, safe, resilient and sustainable.
SDG 11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities, and older persons.

There is broad alignment internationally in the understanding of the priority which now needs to be given to road crash injuries and the path which all countries need to take. Global organisations concerned with road safety (e.g. World Bank, WHO, ITF/OECD, World Road Association) highlight that:

- road death and serious injury is largely preventable unlike road crashes in general which are not;
- the humanitarian and social cost is highly unacceptable;
- road safety is an urgent global priority requiring scaled-up investment;
- leadership and capacity building are vital;
- countries should move straight to effective practice and adopt the Safe System approach as they address the new Sustainable Development Goals.

2.3.2 EU ambitions

In 2011, the European Union, as the leading world region in road safety set an even more ambitious goal to move close to zero fatalities in road transport by 2050, supported by a target to halve road deaths by 2020.[27] In the Valletta Declaration in March 2017, EU Transport Ministers called for serious injury target-setting to 2030 within the framework of a road safety strategy.[28] The European Parliament has consistently supported Vision Zero and also called for further target-setting to 2030 in its last road safety resolution.[29] High Level Group Road Safety meetings and stakeholder meetings continue to strongly support more ambitious activity.

2.3.3 The Safe System goal and approach

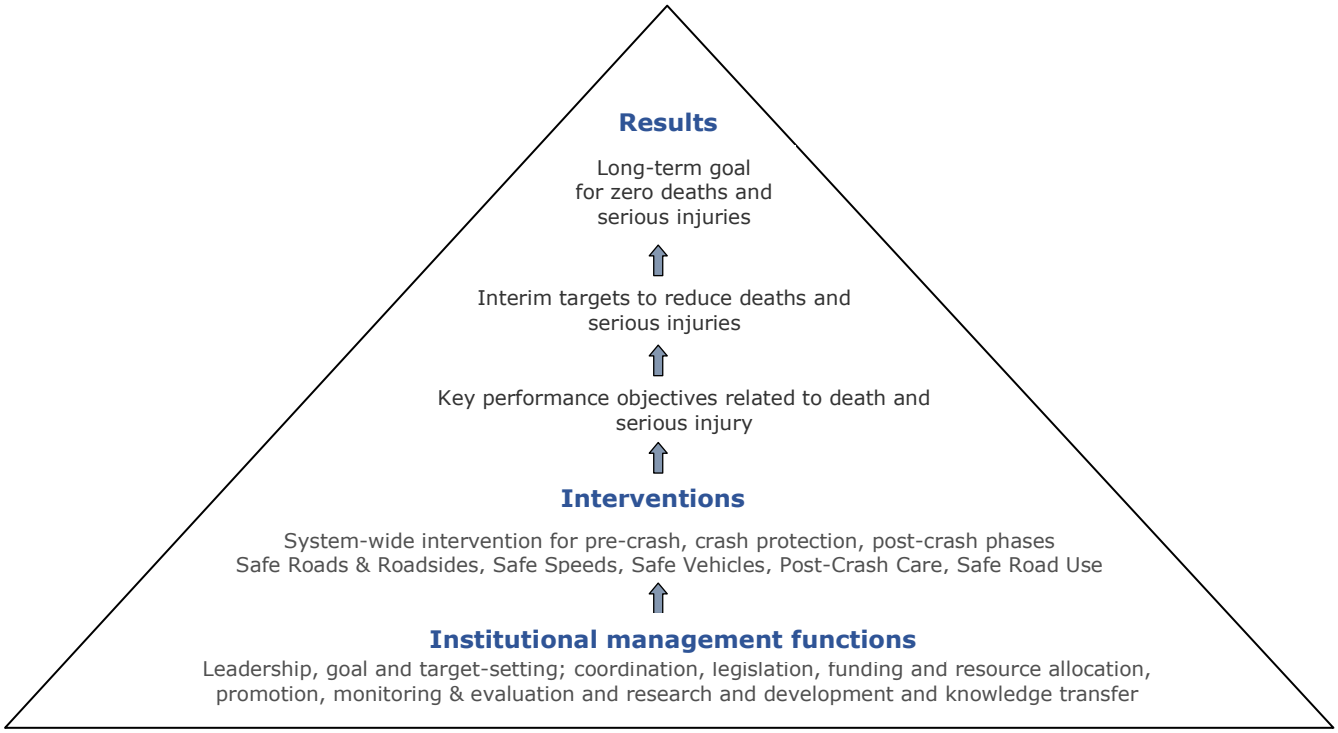
Safe System is the generic terms for concepts derived from European best practice such as Vision Zero, Towards Zero and Sustainable Safety which are being widely adopted worldwide at national, local and city levels. Safe System is an ambitious approach to road safety management, based on well-established safety and organisational principles which systematically address key elements of the road traffic system. It is a synthesis of current knowledge about how to effectively manage for ambitious results. Safe System is the internationally recommended approach to all countries, irrespective of their stage of development or safety performance.[30] [31] [32]

Safe System comprises both an explicit goal and strategy. The long-term Safe System goal is for the ultimate prevention of deaths and serious injuries, supported by interim, time-limited targets and key performance objectives and indicators. This framework for road safety strategy has long been recognised as global best practice.

[27] European Commission (2011). White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system COM(2011) 144 final, Brussels, 28.3.2011.
[28] Valletta Declaration on Improving Road Safety (2017)
[29] European Parliament resolution of 14 November 2017 on saving lives: boosting car safety in the EU (2017/2085(INI))
[30] OECD/ International Transport (2008). Towards zero: ambitious road safety targets and the safe system approach.
[31] OECD/International Transport Forum (2016), Zero Road Deaths and Serious Injuries: Leading a paradigm shift to a Safe System OECD Publishing, Paris.
[32] World Road Association (PIARC) (2015) Road Safety Manual https://roadsafety.piarc.org/en

The adoption of the Safe System approach towards zero is the globally recommended path to effective road safety management. Target-setting in road safety leads to better road safety results and better use of public resource (OECD, 2004, 2008).

Figure 2: Safe System results, intervention and delivery framework [33]



Working towards the Safe System goal and approach are important developments and will require a substantial reorientation of road safety policy and practice over the next decades. It represents a major paradigm shift for next road safety steps. Not least, the sheer scale of the ambitious goals and targets will necessitate alignment with other EU societal objectives such as sustainable development and environmental protection, energy security, economic development and public health as well as occupational health and safety. Given sufficient stimulus, encouragement and the right frameworks for integration, these initiatives should lead to building even better business cases for road safety initiatives and achieving co-benefits.

The Safe System strategy aims for a more forgiving road system that takes human fallibility and vulnerability into account. The road traffic system is planned, designed, operated and used such that people are protected from death and serious injury in road collisions. According to the OECD there are four principles which underpin the Safe System approach: [34]

- People make mistakes and occasionally disobey the rules which lead to death and serious injury

[33] This safety management framework is based on World Bank Global Road Safety Facility, Bliss and Breen (2009) building on the frameworks of Land Transport Authority (2000), Wegman, (2001), Koornstra et al (2002), Bliss, (2004), and updated with reference to World Road Association (2015); OECD/ITF (2016)

[34] OECD/International Transport Forum (2016), Zero Road Deaths and Serious Injuries: Leading a paradigm shift to a Safe System OECD Publishing, Paris.

We make mistakes that have serious consequences. According to OECD analysis of selected countries, around 30% of serious road crashes are caused by deliberate offences and risk-taking behaviour. More commonly they result from simple errors of perception or judgement by otherwise compliant users. Safe System seeks to accommodate human error.[34]

- The human body has a known and limited ability to tolerate crash forces before harm occurs
  Safe System takes account of the tolerance of the human body to crash impact (kinetic energy) forces and seeks to ensure that no road user is subject to a crash impact force that will result in death or serious injury. Current road traffic system designs allow speeds which exceed human tolerance to impact. A safe road traffic system needs to be tolerant of the physical limitations of all road users, including the most vulnerable to accommodate common human error.
- Shared responsibility for achieving road safety results is needed
  Road safety is a complex multi-sectoral activity and needs to be an accountable, shared responsibility. Responsibility for safe travel is borne principally by the agencies who design and operate the road network, those concerned with ensuring vehicle safety, providers of emergency medical assistance and effective trauma care and rehabilitation of victims. People who use the roads also play a part through compliance with key safety rules and user standards which relate to the prevention of death and serious injury. All system elements including speed, road/roadside, vehicle, emergency system and road users work together to provide a road transport system that accommodates inevitable human errors and protects road users from harm. This involves government, business and civil society and large and small organisations.
- Strengthened management is needed
  This involves a planned, systematic, results-focused response for the long-term and interim based on a thorough base of knowledge of where the largest and most cost-effective gains are to be made. Meaningful shared responsibility requires careful leadership from the Government lead agency, key agencies and the top management of organisations. It involves adopting a long-term goal to eliminate death and serious injury, supported by interim quantitative targets to reduce deaths and serious injury. Closer management is also achieved by measuring and targeting intermediate outcomes which are referred to throughout this report as key performance indicators. These are directly related to the prevention of death and serious injury, as used in managing by objectives Safe System strategies. While more will need to be devised to facilitate changing the road transport and travel system into an inherently safe system, a range of safety management tools are currently available to support Safe System implementation which could be used more widely. These include:
  - Road safety management capacity review to assess the readiness of actors to work together to contribute to achieving road safety results;
  - the ISO 39001 road traffic safety management system standard for organisations;
  - Euro RAP risk assessment and safety ratings to assess the quality of the road network
  - Euro NCAP safety ratings to assess the safety quality for the new fleet
  - Fatal collision investigation protocols established by the Safety Net project.
  - A range of guidance on Safe System implementation by the OECD, World Road Association, World Bank and World Health Organisation.

Conclusion

The heightened ambition for better road safety results expressed by the EU institutions requires a stronger, planned, systematic road safety approach at EU, national and local levels. The internationally recommended Safe System approach and performance framework represents the current best practice phase in road safety management. Its wide adoption is needed to provide more focus for professional efforts across EU countries to address road safety goals and targets. Its implementation will need to be supported by a range of EU activity including the setting of a new safety performance framework, making greater use funding mechanisms, Safe System demonstration projects and guidance on Safe System implementation. The Commission will need to review its capacity to fully implement a Safe System approach towards zero deaths and serious injuries. A high-level stakeholder workshop held in January 2018 also identified the setting up of a European agency to provide support on road safety matters as a priority need.

2.4 Safe System and key safety performance indicators (KPIs)

2.4.1 Introduction

This section looks at the role of key performance indicators (KPIs)in road safety strategy and their use in EU countries and beyond. It draws primarily on recent reviews by SWOV for the purposes of this study, ETSC reviews, previous ERSO work carried out for the Commission [35] as well as some national experience in 'managing by objectives'.

2.4.2 What are key safety performance indicators (KPIs)?

Key performance indicators are measurable activities which are directly related to the prevention and mitigation to death and serious injuries. The purpose of using KPIs is to:

- support long-term goals and interim targets;
- allow closer management and measurement of road safety;
- explain systematic developments in safety performance over time;
- provide guidance to all key actors on priority activity;
- provide objectives amenable to accountable, multi-sectoral activity;
- allow comparisons of safety performance of different road traffic systems (national, regional etc.).
- guide policy making towards effective measures to improve a specific key KPI

Some KPIs are much simpler to define than others which are highly complex. The principles underpinning best practice definition and implementation are as follows:

- KPIs are directly related to the operational conditions which influence road death and serious injury.
- When the KPI increases, the safety level also increases. As a road death or serious injury is seen as a system failure, so is a low level of KPI.
- KPIs are usually but not always considered properties of (a certain proportion of) distance travelled. Ideally, properties of roads, vehicles or drivers are to be weighted with their relevant traffic volume or distance travelled.

[35] European Commission (2017), Monitoring Road Safety in the EU: towards a comprehensive set of Safety Performance Indicators, European Commission, Directorate General for Transport, Brussels.

- KPIs are defined in such a way that they can be used quantitatively.
- KPIs need to be measured and monitored periodically and independently of each other and of road crash data.
- A long-term and interim target can be attributed to the KPI.
- The KPI set addresses the needs of all road users.
- The group of crashes that is affected by the KPI can be identified.
- Road safety measures can be identified to achieve the KPI target.
- KPIs are feasible and involve a reasonable cost for administrations.

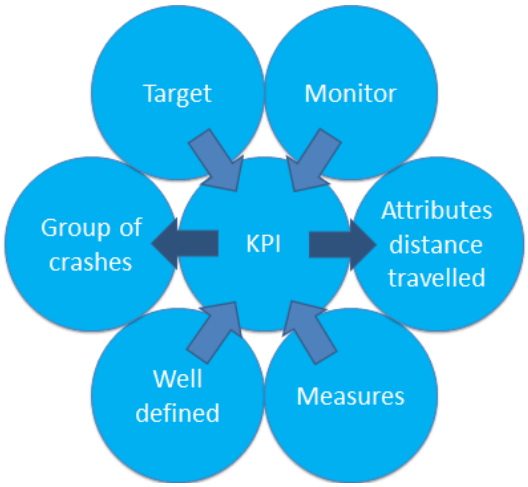


Figure 3. Set up of the different relevant properties of an effective Key Performance Indicator KPI.

A common perception in road safety is that human error is by far the most important contributory factor to road crashes and their outcomes. Research concerning crash injury causation indicates that, while a key factor, the role of human behaviour may have been overstated or oversimplified in past research methodologies.[36] While human error is indeed a key factor in crash *causation*, the *solution* often lies in improved roads, vehicles or enforcement. Factors contributing to serious and fatal road crashes and their outcomes are differently distributed compared with those associated with crashes of all severities which is a central consideration in addressing EU road fatality reduction targets.[37,38] The extent to which road traffic system elements address known human tolerance thresholds and other human characteristics is also important. A focus on road network safety factors, vehicle safety factors, emergency medical system factors that address common human error as well as offering crash protection and injury mitigation to address known human characteristics is key to identifying actions to address goals and targets for serious and fatal injury. The speed of motorised vehicles is central since it affects both crash causation and crash severity and influences the effectiveness of a range of measures. This understanding forms the basis of the *Safe System* approach.

The key identified fields for KPIs which serving a Safe System approach are:

- Measurable safety quality of roads and roadsides

[36] Kimber R (2003). Traffic and Accidents: Are the Risks Too High? TRL, Imperial College London.
[37] Stigson H, Krafft M, Tingvall C (2008). Use of fatal real-life crashes to analyse a safe road transport system model, including the road user, the vehicle, and the road. Traffic Injury Prevention 9(5): 463-71.
[38] Stigson H, Kullgren A and Krafft M (2011). Use of Car Crashes Resulting in Injuries to Identify System Weaknesses. Paper presented at the 22nd International Technical Conference on the Enhanced Safety of Vehicles (ESV). Washington DC. DOT/NHTSA.

- Measurable safety quality of new vehicles
- Level of emergency medical response
- Levels of use of seat belts and child restraints
- Level of crash helmet use by powered two-wheeler users and cyclists
- Level of driving without alcohol or drugs
- Level of driving within the posted speed limit
- Level of driving without distraction
- Levels of speeds on different road types

These fields represent the key elements of a Safe System approach. They comprise the key underlying operational conditions which are influencing levels of death and serious injury on the road today and for the foreseeable future. They are acknowledged internationally as being well researched and having a strong evidence base. They are recommended in international guidance from global organisations such as the ITF/OECD, the World Health Organisation, the World Bank, the World Road Association and in EU-supported research.[39] [40] [41] [42] [43] All, or most, are adopted in policies and practice in countries which have come the furthest in implementing Safe System, as outlined in the example below in Table 2.

A discussion of possible KPIs for take up in EU road safety strategy; their relationship to the prevention and mitigation of death and serious injury and rough estimates of their potential effect are provided in Section 4.

The sources of data on KPIs across EU countries is available within the European Transport Safety Council's (ETSC) Road Safety Performance Index (PIN) Project and the ESRA survey of self-reported attitudes and behaviours.[44] [45] Several EU Member States collect some indicators on a regular basis and ETSC has been collecting data on a range of different topics since 2006 demonstrating that, although challenging, it is certainly feasible to measure performance in different areas of road safety in this way. ETSC's PIN Project also shows how data collection, analysis and benchmarking can be a strong road safety tool for motivating action and galvanising political will at national and EU levels. An overview of current performance in various EU countries is provided in the discussion of possible EU indicators in Section 4.

At global level, governments have recently reached consensus on a set of global KPI targets in support of Sustainable Development Goals.[40] Using and targeting progress with KPIs is also common practice in Australasia. However, according to a recent review it is less common for EU countries to use KPIs beyond monitoring progress by proactively integrating it in target-setting in national road safety strategies. Although targets for fatality and serious injury reduction are commonplace, only a small group of EU countries has set numerical targets based on KPIs.[46] These include Ireland, Sweden, Spain and the UK (for the strategic road network). Norway leads road safety performance in Europe and has set a range of KPI targets in support of long-term

[39] OECD/International Transport Forum (2016), Zero Road Deaths and Serious Injuries: Leading a paradigm shift to a Safe System OECD Publishing, Paris.
[40] WHO (2017). Global road safety performance targets. http://www.who.int/violence_injury_prevention/road_traffic/12GlobalRoadSafetyTargets.pdf?ua=1
[41] World Bank (2009, 2013) http://www.worldbank.org/en/topic/transport/publication/road-safety-management-capacity-review-guidelines (accessed 23.3.18)
[42] World Road Association (PIARC) (2015) Road Safety Manual https://roadsafety.piarc.org/en
[43] European Commission (2017). Monitoring Road Safety in the EU: towards a comprehensive set of Safety Performance Indicators, European Commission, Directorate General for Transport, November 2017
[44] ETSC PIN Project. See http://etsc.eu/projects/pin/ accessed 29.1.18.
[45] E-Survey of Road User Attitudes (ESRA). See http://www.esranet.eu/ accessed 29.1.18.
[46] European Commission (2017), Monitoring Road Safety in the EU: towards a comprehensive set of Safety Performance Indicators, European Commission, Directorate General for Transport, Brussels.

goals and targets to prevent and reduce fatal and serious injury. These include user compliance with safety rules, speed management, the safety quality of the vehicle fleet (including HGVs) and the road network. Some countries, such as the UK, target progress using a Euro RAP star rating KPI for the strategic road network The KPIs set by Sweden, the current leader in EU road safety performance and one of the more advanced countries in implementing a Safe System approach, are set out in Table 2.

Table 2: KPIs in Swedish Managing by Objectives approach

INDICATOR	START POINT	2015	2020 TARGET	REQUIRED TREND
Share of traffic volume within speed limits, national road network	43%	46%	80%	Not in line
Share of traffic volume within speed limits, municipal road network	64%	64%	80%	Not in line
Share of traffic volume with sober drivers	99.71 %	99.77%	99.90%	Not in line
Share of front seat passenger car occupants wearing a seat belt	96%	98%	99%	In line
Share of cyclists wearing a helmet	27%	38%	70%	Not in line
Share of moped riders using a helmet correctly	96%	97%	99%	Not in line
Share of new passenger cars with the highest Euro NCAP score	20%	63%	80%	In line
Share of safe motorcycles (ABS)	9%	44%	70%	In line
Share of traffic volume in roads with speed limit above 80 km/h and median barriers	50%	73%	75%	In line
Share of safe pedestrian, cycle, moped crossings in main municipal road networks	19%	25%	Not defined	
Share of municipalities with good-quality maintenance of pedestrian and cycle paths	15%	Not measured	70%	

Source: OECD/ITF 2016. Road Safety Annual Report 2016. Paris.

Conclusion

The aspirational nature of long-term goals and targets set at EU level needs to be addressed by key safety performance indicators which represent the underlying operational conditions underpinning fatal and serious injury prevention. This will enable closer and more focused safety management by different levels of government and encourage multi-sectoral activity along demonstrably effective lines.

2.5 Aligning road safety with other societal goals and objectives

The scale of the road safety challenge, the diversity of effects of road traffic injury on a range of sectors and the high ambition for the ultimate eradication of death and

serious injury all underline the importance of exploring synergies with other societal goals and priorities. Coordination with a range of sectors is needed to explore how further advocacy efforts, budgets and interventions undertaken by these can expand the scope and capacity of road safety management. The World Road Association has carried out a recent, comprehensive review of the opportunities presented by this approach, on which this section draws heavily. [47]

In EU and national transport policy, *safe, clean and affordable mobility goals* are set increasingly to achieve co-benefits of integrated initiatives. Significant co-benefits can be achieved for the *environment, public health* and *road safety*. For example, land use and transportation planning, the provision of safe infrastructure facilities to promote increased walking and cycling (where the challenges of simultaneously enhancing take up of cycling and ensuring safe cycling are large), and measures to reduce vehicle speeds will, in addition to safety benefits, also result in less greenhouse gas emissions and local air pollution, greater energy security, and improved physical wellbeing. Other means include reducing the volume of motor vehicle traffic by providing for public transport and pursuing *Liveable City, Safe City policies*; providing efficient networks where the shortest or quickest routes coincide with safe routes; and encouraging road users and freight to switch from higher risk to lower risk modes of transport.

Road safety can also be aligned with *tourism goals* since the risks of road traffic injuries are appreciably higher for tourists than health risks such as epidemics; illnesses; personal security risks associated with international terrorism, violence and crime; travel injury risks on modes other than road transport modes; and other personal injury risks such as drowning.

Road safety also aligns well with societal provisions for the *rights of the child and citizens.* Governments signing the Convention are required to provide a safe environment and protection to children from injury and violence[48]. The Tylösand Declaration by Swedish road safety agencies and stakeholders in 2007 in a broader statement of rights stated that everyone has the right to use roads and streets without threat to life or health. In *regional and neighbourhood policies,* road safety improvements can contribute substantially to *poverty reduction* goals and *international development*. Road crash victims typically involve the most economically active of citizens, often with adverse impacts on those who depend upon their efforts. Road safety can also be seen as a *social equity issue* with vulnerable road users benefiting the least from policies designed for motorised travel but bearing a disproportionate share of the disadvantages of motorisation in terms of injury, pollution and the separation of communities.

Road safety needs to be at the heart of *occupational health and safety objectives* since road traffic injury is a leading contr*i*bu*tor* to *w*ork-rel*a*ted death. In addition, work-related road safety can contribute to substantial reductions in employers' costs and have a substantial impact on national and organisational goals for occupational health and safety.

Not least, activity to address death and serious injury in road traffic is inter-linked to *economic objectives*. The value of prevention of the death and injury burden, is substantial and estimated at around 1.8% EU GDP for reported crashes increasing to

[47] World Road Association (PIARC) (2015). Road Safety Manual: A manual for practitioners and decision makers on implementing safe system infrastructure, World Road Congress (PIARC), Paris. https://roadsafety.piarc.org/en/introduction

[48] The Convention on the Rights of the Child, UN General Assembly Resolution 44/25 (1989),

3% when underreporting is taken into account.[49] Road safety also contributes to the sustained quality and international competitiveness of EU goods and services.

Conclusions
The aspirational nature of ambitious long-term goals and targets set at EU level also necessitates a broadening of scope of the road safety task and galvanising shared responsibility for safety results. Road safety goals, targets and objectives need to be aligned with sustainable development goals to build even stronger business cases for road safety intervention. New inter-service coordination arrangements between Commission Directorates will be necessary to ensure that core road safety responsibilities are understood to allow the achievement co-benefits from EU action. The establishment of a safety results framework of goals targets and objectives based in KPIs will be needed to provide focus for successful coordination.

3 Current status of road safety in the European Union and future prospects

3.1 Introduction

This section presents a review of EU progress in road safety and assesses *Policy Orientations* in terms of the *results* achieved, *interventions* implemented and other aspects of *institutional delivery*. This comprises both quantitative and qualitative assessments with the aim of updating the assessments made in the comprehensive work carried out previously.[50] [51] The qualitative assessments review EU activity carried out since 2015. Taking account of the conclusions derived in Section 2, some broad conclusions are drawn concerning future challenges and opportunities for next EU road safety steps.

3.2 Results

A summary quantitative analysis is presented of EU road safety results and past trends. This section outlines key road safety problems and progress towards the 2020 fatality reduction target against the 2010 baseline. Headline estimates use available 2016 and 2017 data, but the more comprehensively returned 2015 data set is used for disaggregated presentation, as agreed with the Commission.

While new and appropriate consideration continues to be given to serious injuries in the *Policy Orientations* strategy, insufficient comparative date is currently available and, hence, the main focus in this quantitative presentation is road deaths.

3.2.1 Final outcomes: road deaths, serious injuries, value of prevention

Road deaths: progress against 2020 target, numbers, rates
Substantial progress has been made in reducing road deaths over the last two decades, aided by goal, target and strategy setting. Between 2000 and 2017 there has

[49] Wijnen, W et al (2017), https://www.safetycube-project.eu/wp-content/uploads/SafetyCube-D3.2-Crash-costs-estimates-for-European-countries.pdf.
[50] European Commission (2015). DG MOVE Unit C4: Road safety. Interim evaluation of the Policy orientations on road safety 2011-2020, Brussels
[51] Breen J (2015). Road safety study for the interim evaluation of Policy Orientations on Road Safety 2011-2020, 12 February 2015,

been a 56% reduction in road deaths. EU leads the world in road safety and its performance is an international success story.

However, the rate of road safety progress has slowed over the last three years (Figure 4). Since 2010, a 20% reduction in deaths has been achieved which makes meeting the 2020 target to reduce deaths by 50% highly challenging if not improbable. To achieve the road safety target for 2020, an annual reduction of around 12.8% is required over the next 3 years. This is illustrated in Figure 4, where the number of road deaths between 2000 and 2016 are plotted (based on CARE/CaDaS), together with an estimate for 2017, based on provisional data.

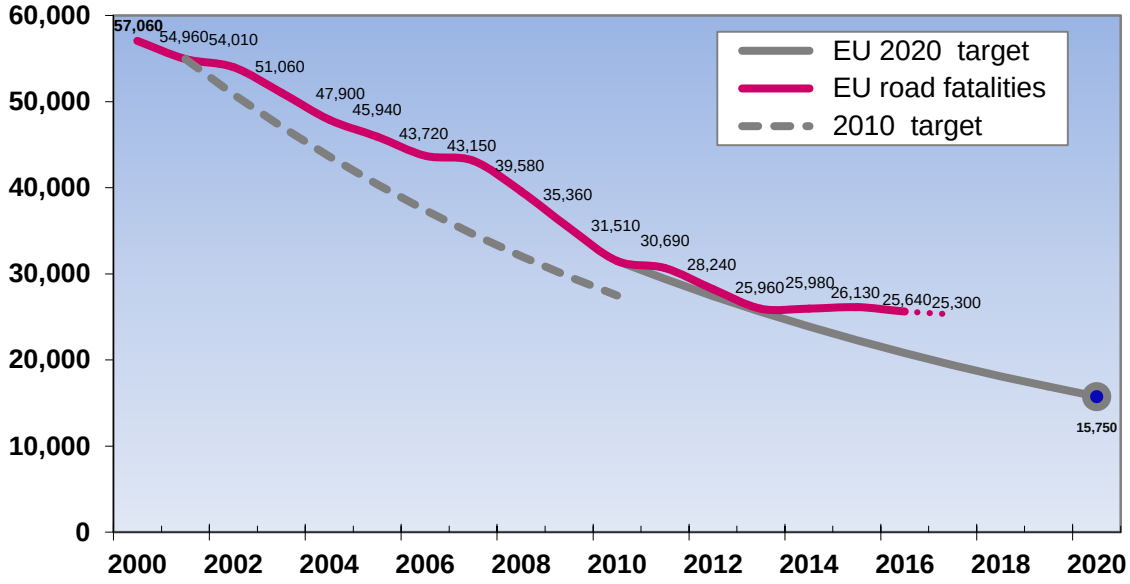


Figure 4: Progress against EU targets 2000-2020 Source: CARE database, 2017

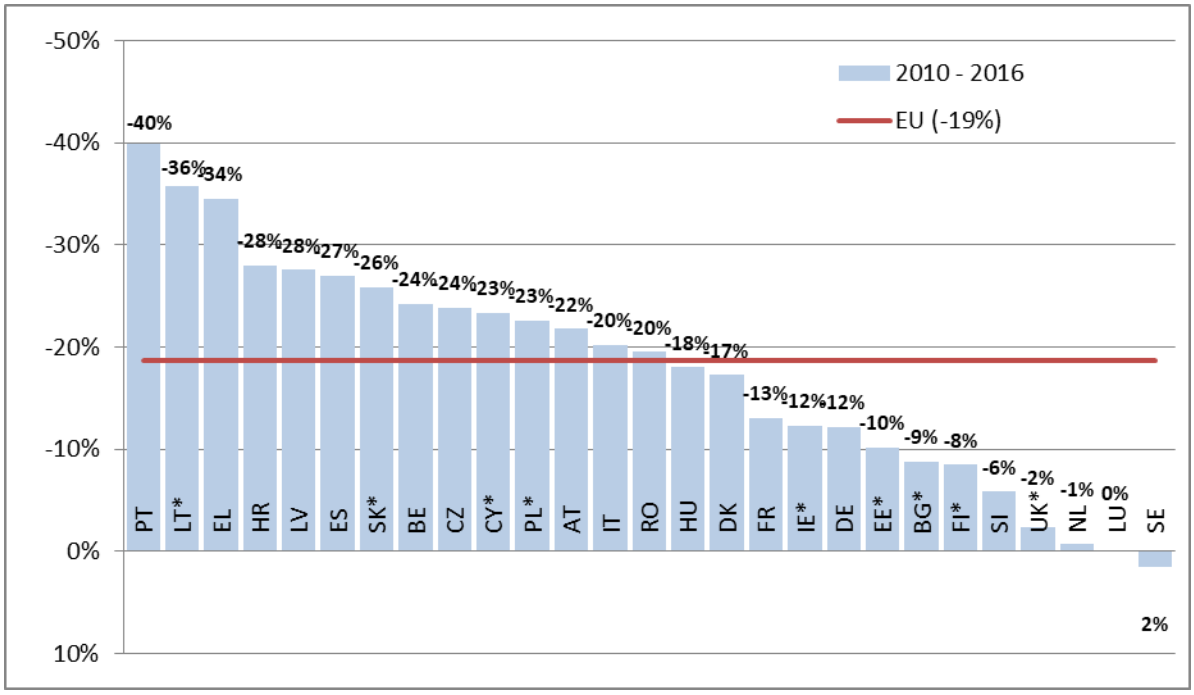
Annual road deaths: number and rates

Each year, over 99% of total transport passenger deaths result from road crashes.[52] In 2016, 25,600 people were killed in road collisions the EU 28. This represents a 19% decrease compared with the 2010 baseline and represents a 3.4% average annual reduction. Provisional figures for 2017 indicate that there were around 25,300 road deaths.

The road fatality outcomes in 2016 show a mixed picture (Figure 5) when comparing the development since 2010. Some countries report large reductions, others indicate slow progress and others report an increased number of road deaths.

[52] European Commission (2017) EU Statistical Pocket Book, Brussels.

Figure 5: EU Road deaths 2010-2016



Source: CARE (EU road accident database. 2010, 2016) and National Statistics (*2016)
Malta is not shown for small numbers and statistical fluctuations.

The world's best road safety performers are to be found within EU countries and most Member States have improved their road safety records since 2010. However, road safety performance is uneven across the region and there is a threefold gap in road death rates between the better and worse road safety performers. Average mortality over the last three years varies between 27 and 94 road deaths per million population, with an average of 51 road deaths per million in EU28.[53] In 2015, most EU countries recorded a fatality rate below 80 deaths per million inhabitants.

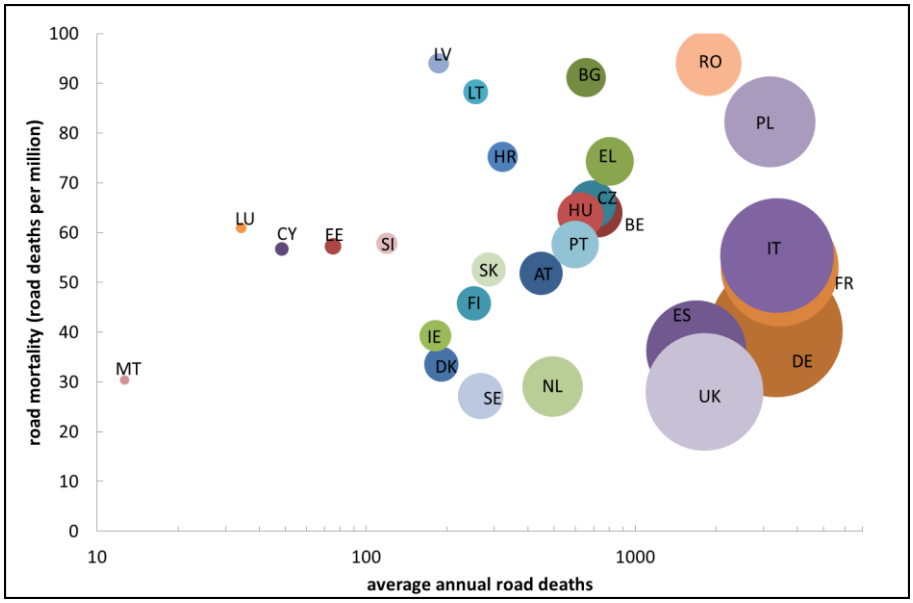
In 2015, countries with the lowest mortality (per million) were Sweden (27), the UK (28), Denmark (31), the Netherlands (31) and Malta (26). Those with the weakest road safety records were Bulgaria (98), Romania (95), Latvia (95), Lithuania (83), and Croatia (82).

EU countries are of a very different size. There are several countries with a high population and a large number of road deaths. At the same time, there are many small countries where the road safety improvement, although essential for joint success, contribute modestly to the EU road safety level in an absolute sense.

Figure 6 illustrates that the road safety policy success of the EU depends to a large extent on the implementation of effective measures in seven large countries which, together, determine the vast majority of all road deaths in the EU. If large countries with comparatively worse rates could meet the performance of the best, then overall numbers will fall. At the same time, further progress is needed in those countries with comparatively good overall rates to make even further progress if numerical targets are to be addressed.

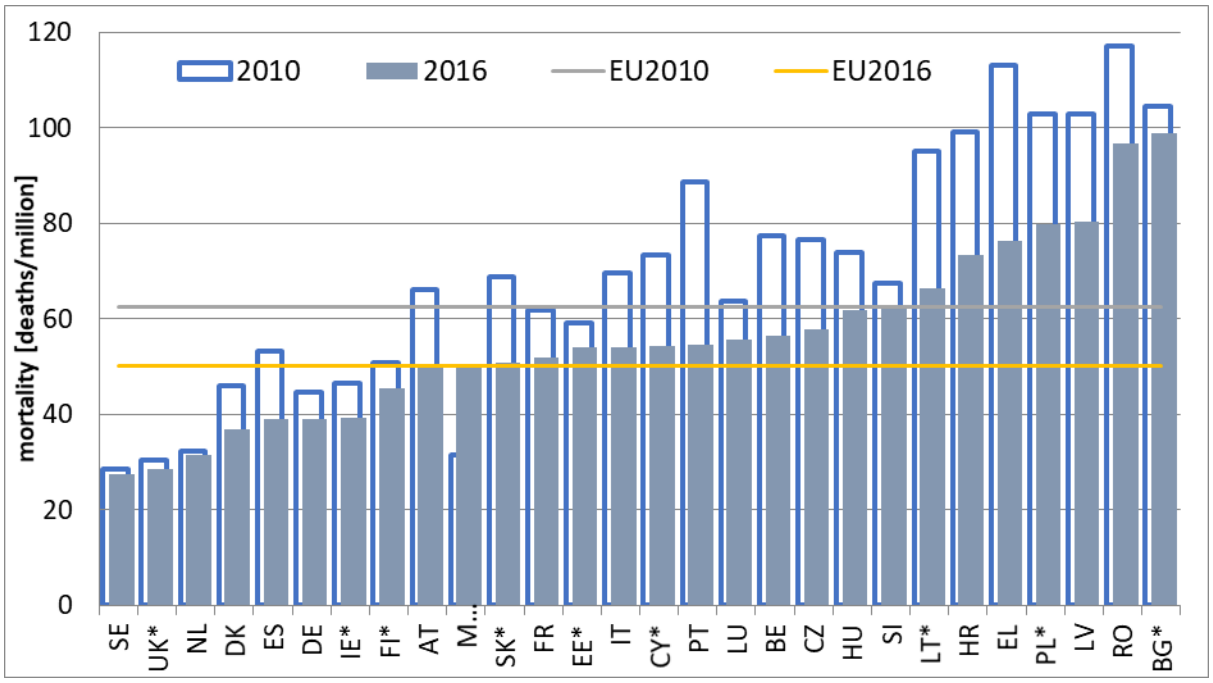
[53] European Commission (2017). CaDaS, Brussels.

Figure 6. Road deaths and mortality for EU28 by Member State



Source: CARE data (3-year average, different years); SWOV, 2017

Figure 7: EU Road death rates per million population 2010-2016.



Source: CARE (EU road accident database. 2010, 2016), National Data (*2016), Eurostat population.

Road deaths by gender, user type, age

Most deaths in road collisions across EU countries are males, car occupants and young adults. Inequalities in the risk of death in road crashes are evident by gender, road user type and age.

The vast majority of deaths in 2015 involved males (76%) and 24% were females. Males have three times the death rate of females and demonstrate riskier behaviours such as speeding.[54]

For the EU as a whole in 2015, nearly half of road fatalities (45%) were car occupants. Pedestrians contributed the largest share of vulnerable road user deaths (22%) followed by powered two wheelers (18%) and 8% of all road deaths were cyclists. The specific contribution of different road user groups to overall fatality totals differs in many Member States due to modal split and other factors. Compared with 2010, the largest proportional decreases in EU road deaths in 2015 were for car occupants, powered two-wheeler riders (especially mopeds) and van occupants. As shown in Table 3 the rate of decline in deaths between 2010 and 2015 was markedly slower amongst cyclists and bus occupants than for other groups.

Table 3: Road deaths by road user type

Road user type	*proportion of all known types 2015*	*change in number of deaths 2010-2015*	*change in number of deaths 2001-2015*
Car occupants	45%	-21%	-58%
Pedestrians	22%	-15%	-45%
Motorcycle riders	15%	-14%	-27%
Bicycle riders	8%	-2%	-36%
Moped riders	3%	-36%	-68%
Van occupants	3%	-17%	-35%
HGV occupants	2%	-21%	-62%
Agricultural vehicle users	1%	-13%	-43%
Bus occupants	1%	-5%	-59%
Other road users	1%	33%	1%

Source: CARE (EU road accident database) 2000-2015. For 6% of fatalities the road user type is unknown. 2014 data were substituted for missing 2015 data for Ireland. A weighting 162/193 was applied as the total number is known.

Most reported deaths in road crashes involve motor vehicles, the majority involving passenger cars, as shown in Table 4.

Table 4: Road deaths involving different motor vehicle types

Vehicle type involved	*proportion of deaths 2015*
Cars	75%
Powered two wheelers	20%
Heavy goods vehicles > 3.5 tonnes	15%
Goods vehicles <3.5 tonnes	10%
Buses	3%

Source: CARE data 2015. For BG, IE and SK no data by involvement were available, so these countries were excluded from this analysis. 2014 data were substituted for missing 2015 data for Ireland. A weighting 162/193 was applied as the total number is known.

[54] European Transport Safety Council (2013). Back on track to reach the EU 2020 Road Safety Target, 7th Road Safety PIN Report, Brussels.

The large variation in fatality risk on EU roads amongst different types of road user and between protected and unprotected groups is well-known.[55] Recent data adjusted for distance travelled is not available at EU level. However, analysis in one Member State where recent travel data is available indicates that motorcyclists are by far at the highest risk of death (accounting for less than 1% of traffic but 15% of fatalities in 2015), with pedal cyclists and pedestrians forming the next highest risk groups. While comprising the largest share of deaths, car occupants sustained the lowest risk of these modes.[56]

EU road deaths by age-groups have been reduced since 2010 particularly for the under 40 years age groups. As shown in Table 5, the rate of decline between 2010 and 2015 is markedly slower for those aged over 50 years. The number of road deaths among the very old (above 80 years) is increasing.

Table 5: Road deaths by road user age: 2015

Road user age	*Proportion in 2015*	*change in number of death 2010-2015*	*change in number of deaths 2001-2015*
<15	2%	-25%	-69%
15-17	2%	-35%	-71%
18-24	14%	-31%	-66%
25-29	8%	-23%	-62%
30-39	13%	-26%	-62%
40-49	14%	-19%	-51%
50-59	14%	-13%	-38%
60-69	12%	+0%	-39%
70-79	11%	-6%	-41%
80+	10%	+11%	-1%

Source: CARE (EU road accident database) 2000-2015. Unknown ages were distributed over known ages by the proportion of known ages in the same year. Source: CARE data 2015. For BG, IE and SK no data by involvement were available, so these countries were excluded from this analysis.

Global Burden of Disease data for 2010 in 26 EU countries indicate that road traffic injury was the leading or second leading cause of death for school aged children and young people (5-24 age group). In 21 EU countries (75%), road traffic injury was amongst the three leading causes of death for those aged 5-49 years.[57]

Road deaths by road type

In 2015, some 54% of deaths in road collisions (14,000) occurred in non-built-up areas, 38% (9,700) in built-up areas and 8% (2,000) on motorways. Since 2010 reductions in deaths occurred in all road types, although the rate of decline was markedly less for motorways than for other road types, as shown in Table 6.

[55] European Transport Safety Council (2003) Transport safety performance in the EU: a statistical overview, Brussels.
[56] Department of Transport (2014) Reported Road Casualties Great Britain: Annual Report 2013, HMSO.
[57] Institute of Health Metrics and Evaluation IHME (2013). Global Burden of Disease: Generating Evidence, Guiding Policy, Institute of Health Metrics and Evaluation, University of Washington, Seattle.

Table 6: Road deaths by road type: 2015

Road type	*share of all known road types*	*change in number of death 2010-2015*	*change in number of deaths 2001-2015*
Non-built-up areas	54%	-18%	-54%
Built-up areas	38%	-18%	-51%
Motorways	8%	-13%	-55%

Source: CARE (EU road accident database) 2000-2015.
Unknown road types for 2001 (BG, CY, EE, HR, HU, LV, MT), 2010 (BG) and 2015 (BG, SK) were distributed by the proportion of road types according to years where this data was available for that country. 2014 data were substituted for missing 2015 data for Ireland. A weighting 162/193 was applied as the total number is known.

Road deaths: at work or travelling to work

While statistical information is limited, work-related motor vehicle crashes are a leading cause of death and long-term injury in the workplace and in driving associated with work. In several EU countries, around 40% of all work accidents resulting in death are road crashes while using the road for work and while commuting.[58] [59]

Serious injuries

While EU road deaths are decreasing annually, less progress has been made with reducing serious injuries. It is estimated that around 135,000 citizens are seriously injured on European roads using the common serious injury definition (2014 CARE data). According to national definitions, serious injuries were reduced by just 0.5% since 2010.

Serious and fatal crash types

The main road traffic crash types which need to be addressed to reduce fatal and serious injury on EU roads are:[60] [61]

- Head-on crashes typically kill and seriously injure car occupants even in the best designed vehicles at speeds greater than 70km/h. In-depth research shows that frontal crashes account for about 55% of passenger car fatalities and serious injuries. Several factors influence crash severity, the most important being speed of travel, seat belt use, vehicle mass and the level of crash protection and mitigation provided in the vehicle.
- Side impacts at intersections typically kill and seriously injure car occupants even in the best designed vehicles at speeds greater than 50km/h. Of passenger car fatalities and seriously injured, side impacts account for about 35% to 40%.
- Run-off-road crashes into rigid fixed objects produce a high number of fatal and serious outcomes at speeds greater than 70km/h for frontal impacts and 50km/h for side impacts even in the best designed vehicles.
- Other motor vehicle impacts. The remainder include rear impacts (5%) and other impact types.
- Walking and cycling across or along the road. Recent comparative estimates of relative fatality risks across the modes are not available - an information gap which need to be addressed urgently. The only EU study carried out of relative risk across the modes indicated that the risk (death per distance travelled) of being killed in traffic is 9 times higher for pedestrians than for car occupants and 7 times

[58] DaCoTA (2012). Work-related road safety, Deliverable 4.8v of the EC FP7 project DaCoTA, Brussels.
[59] ETSC (2017) Tapping the potential for reducing work-related road deaths and injuries-pin-flash-33
[60] United Nations Road Safety Collaboration (UNRSC) (2011). Safe Roads for Development: A policy framework for safe infrastructure on major road transport networks, WHO, Geneva.
[61] Euro NCAP (2014). 2020 Roadmap, European New Car Assessment Programme, Brussels.

higher for cyclists.[62] Pedestrian and cyclist risk increases steeply in mixed speed traffic when traffic speeds are greater than 30km/h. Research suggests that the majority of all fatally and seriously injured pedestrians in Europe are hit by the fronts of cars.[63] The survival of these vulnerable road users depends upon their separation from the high speeds of motor vehicles or, where shared use is common, sufficiently low vehicle impact speed to prevent severe crash injury and provision of crash protective car fronts and, for cyclists, underrun protection on trucks. Single vehicle crashes are most common for injured cyclists.[64]

Motor vehicle crashes are the leading cause of traumatic brain injury. The priorities for preventing severe injuries in road collisions are head and spinal injuries. Pedestrians and motorcyclists suffer the most severe injuries as a result of motor vehicle collisions, report more continuing medical problems and require more assistance, compared with other types of road user.[64] Fatally injured motorcyclists sustain multiple injuries to the head, chest and legs with the majority to the head, despite helmet use. Lower-leg injuries result either from direct contact with the impacting vehicle or result from impact between the motorcycle and the ground. Head injuries are the major cause of death in around 75% of cyclist deaths and head or brain injury is present in about 50% of all younger hospitalised crash victims.[65]

Social costs and the value of prevention

Recent EU road safety research estimates that the value of preventing reported road crash outcomes across EU 28 is around €270 billion which corresponds to 1.8% of the GDP. If unreported casualties and crashes are taken into account, it is estimated that total costs are in the order of magnitude of at least 3% of GDP (around €470 billion).[66]

3.2.2 Intermediate outcomes

The current performance of EU countries in terms of intermediate outcomes and future prospects are discussed in Section 4 in relation to proposals for an EU set of key road safety performance indicators.

3.3 Interventions and institutional delivery

The independent technical assessment in 2015 carried out a detailed, systematic scan of the main road safety interventions implemented or foreseen within *Policy Orientations* 2011-2020 as well as those measures which were implemented before 2011 and which may now be influencing road safety outcomes. This section updates that assessment based on activity carried out between 2015-2017.

The assessment noted that a wide variety of intervention was foreseen between 2011 and 2020 to address many key road safety problems and with new focus on vulnerable road user safety.

EU measures before 2011:

According to the assessment, the most promising areas of EU intervention which are likely to be influencing current road safety outcomes are previous EU legislative initiatives in vehicle design and safety equipment: electronic stability control system in

[62] ETSC (2003). Transport safety performance in the EU: a statistical overview, Brussels.
[63] European Enhanced Vehicle-Safety Committee (EEVC) (1998 updates 2002). Working Group 17 Report Improved test methods to evaluate pedestrian protection afforded by passenger cars.
[64] Peden M., Scurfield R, Sleet, D, Mohan D, Hyder A, Jarawan, E and Mathers, C. eds. (2004). World Report on Road Traffic Injury Prevention, World Health Organisation, World Bank, Geneva.
[65] DaCoTA (2012). Vehicle Safety, Deliverable 4.8u of the EC FP7 project DaCoTA, Brussels.
[66] Wijnen, W et al (2017), https://www.safetycube-project.eu/wp-content/uploads/SafetyCube-D3.2-Crash-costs-estimates-for-European-countries.pdf.

cars and trucks; daytime running lights in all powered two-wheelers, cars and trucks and pedestrian protection. In many cases fitment started before legislative deadlines, aided by Euro NCAP, industry initiatives and national fast-tracking measures.

Infrastructure safety management of the TEN-T and connecting roads presents an important, ongoing opportunity for improved road safety. An ex-ante impact assessment carried out in 2006 for the road infrastructure safety management Directive 2008/96/EC indicated a potential reduction of around 400 road deaths annually.[67] An ex-post impact assessment indicated much future promise given further developments over time, but no assessment of past safety impact given the lack of safety performance data.[68] This finding is taken up in the Commission's work towards updating the Directive mentioned below.

Directive 2010/40/EC also provided for the mandatory fitment of e-Call which is a system for sending automated emergency calls to the emergency service from vehicles in the event of a crash. The fatality reduction potential was estimated to be between 2% and 10% depending on the country considered.[69] The legislation comes into effect for all new cars from April 2018.

EU measures between 2011-2015:
The previous assessment noted that the introduction of advanced and anti-lock braking systems in motorcycles coming into force in 2018 was the notable safety development which some Member States fast-tracked nationally. However, in general, the interventions during this period were either insufficiently defined in this evolving strategy to allow the estimation of their road safety value or they comprised activity which might lead to the identification of future intervention but without the certainty of implementation. Many actions were noted to be ongoing. The 2015 assessment also noted that implementation since 2011 had been understandably variable, given the complexities of road safety at EU level and often dependent on subsequent and, as yet, unknown decisions by Member States. The Cross-Border Enforcement Directive (EU) 2015/413 was one example which was cited. Furthermore, interventions sometimes insufficiently addressed the largest fatality groups, considered the safe, free movement of people in harmonisation measures or paid enough attention to the evidence base. While a range of valuable preparation had been carried out and important steps taken, the most promising aspects of *Policy Orientations* intervention whether in implementing proven vehicle safety technologies; further developing infrastructure safety or ensuring safety-sensitive powered two-wheeler rider and car driver licensing schemes had yet to be adopted and implemented.

EU measures 2015-2017:
Since 2015 a range of activities has comprised evaluations on previously implemented legislation (cross border enforcement) and work towards revisions of legislation (road infrastructure safety management; vehicle general safety regulation and pedestrian safety regulation; training for professional drivers and rest times for truck drivers). The impact assessment on cross border enforcement found that the new EU rules have had a positive impact on tackling road traffic offences committed abroad with the

[67] Staff Working Document accompanying the Proposal for a Directive of The European Parliament and of the Council Facilitating Cross-Border Enforcement in the field of road Safety Full Impact Assessment {Com (2008) 151} Sec (2008) 350).
[68] European Commission (2014). Study on the effectiveness and on the improvement of the EU legislative framework on road infrastructure safety management (Directive 2008/96/EC) Transport & Mobility, Leuven.
[69] European Commission Staff Working Document Impact Assessment Accompanying the document Commission Recommendation on support for an EU-wide e-Call service in electronic communication networks for the transmission of in-vehicle emergency calls based on 112 (e-Calls) COM 2011,6269 final}

number of investigated offences committed by non-residents increased by four times to approximately 2 million between 2013 and 2015. No estimate is given of the direct impact on casualty reduction. Further improvements were suggested. The developing proposals for road infrastructure safety management and for improvements in vehicle safety, if adopted and implemented are likely to lead to very substantial savings in deaths and serious injuries over time (See Section 4).

A range of studies have been undertaken, some of which are ongoing. These include studies on serious road traffic injuries in the EU; the causation of traffic accidents involving powered 2-wheelers and bicycles in the EU; a study on the implementation of Directive 2006/126/EC on driving licences; driver training, testing and medical fitness to driver; risks and countermeasures for road traffic of elderly in Europe; good practice in reducing road safety risks caused by road user distraction and a feasibility study on the Vehicles Information Platform.

Within the Horizon 2020 multi-disciplinary road safety calls, a range of substantial road safety projects are underway. The 2016 and 2017 calls comprised behavioural aspects for safer transport; safe and connected automation in road transport; the protection of all road users in crashes; transport infrastructure to increase the transport system safety at modal and intermodal level (including nodes and interchanges) and road infrastructure to support the transition to automation and the coexistence of conventional and automated vehicles on the same network. A range of key safety projects from earlier Horizon calls are fully underway. These include SafetyCube, InDev, XCYCLE and PROSPECT.

Other activities included the Commission support for TISPOL's Project EDWARD (2016 and 2017); the Excellence in Road Safety Awards and workshops on best practice for the enforcement of road traffic; on serious road traffic injuries and road user distraction risks.

In 2015, an interim evaluation was carried out by the Commission with a supporting independent study on the effectiveness of the Policy Evaluations strategy. Stakeholder seminars on future road safety steps were organised by the European Commission in March 2017 in Valletta, Malta and in January 2018 in Florence and the current study was commissioned to assist in preparatory work for a new EU road safety strategy 2020-2030.

Overall assessment of Policy Orientations and future prospects

Road safety is produced within a complex multi-sectoral context and across several levels of governance - EU, national, regional and local and involving many actors. Assessment of the value of EU road safety strategy in terms of specific road safety impacts requires a range of well-defined, certain, measurable activity and related performance data at all these levels. In the general absence of these, the conclusions and recommendations drawn in this updated assessment remain as before, at best, on the basis of expert judgement.

In addition, as the previous assessment noted, EU action requires relatively long lead times. Whereas key actions taken in the previous decade will now be contributing to the 2020 target, few actions taken since 2011 are unlikely to have made a major contribution as yet. While a range of valuable preparation has been carried out and important steps taken, the most promising legislative aspects of *Policy Orientations* intervention in the vehicle safety field have yet to be adopted and implemented.

The 2015 study supporting the Commission's interim evaluation of the current strategy, as does this updated assessment, found considerable scope for the further

development of EU road safety goals, targets and evidence-based strategy. There remains a large gap between current results and the rate of progress desired by all the EU institutions to address preventable and unacceptable death and serious injury resulting from road collisions.

A summary of activity carried out during 2015-2017 has been provided by the European Commission and is presented in Annex 3. The preparation of future intervention holds much future promise and, if implemented, is likely to make a very large contribution to better road safety results. Particularly notable elements include the work towards identifying key vehicle safety improvements for new vehicles and improvements to the infrastructure directive which are outlined in Section 4.3.3. However, little or no potential effects within the 2020 target period is identified since much of the activity over the last three years involves future implementation of key measures which may or may not be adopted.

External factors contribute as does the scope, quality, amount of systematic intervention. Better attention to the evidence base and the safety needs of all users will influence results, as will increased scope, amount and quality of intervention and implementation. Future progress will depend upon a sharpening of focus on death and serious injury prevention and mitigation, an inclusive delivery framework and a broadening of scope to align with other societal objectives to scale-up capacity and investment in road safety.

In recent years, the Commission has drawn attention to the importance of addressing serious road traffic injuries at EU level which are many more numerous than road deaths and lead to unnecessary human suffering and societal cost to victims and their families, the health sector and employers. Important *Policy Orientations* initiatives have been undertaken, such as realising a common definition of serious injury and funding in-depth study. EU goal and target-setting now needs to include long-term and interim ambitions for the prevention and reduction of serious injuries.

4 Recommendations for new EU road safety strategy

4.1 Suggested title:

One proposal, in line with international best practice, is that the next EU road safety strategy is a Towards Zero strategy based on the Safe System approach and the following title is suggested:
"En route towards zero in the European Union: Next road safety steps 2020-2030".

4.2 Scope:

4.2.1 Overview of approach

The strategy defines a comprehensive view of where the EU could and should add value on road safety in line with identified good practice road safety management. It presents a planned, systematic, results-focused approach for next steps in road safety to 2030. The focus is on achieving road safety *results*, expressed as goals, targets and objectives, supported by demonstrably effective system-wide *intervention* and

underpinned by *institutional management* and delivery on the part of a wide range of sectors, agencies and stakeholders at EU and national levels.

The strategy sets a Safe System approach to road safety which is underpinned by a best practice results framework (See Figure 4). At the apex is the ethical goal that no fatal or serious injury in road crashes is acceptable to society which is supported by quantified time-limited targets to reduce death and serious injury. The time limited targets are not seen as ends in themselves, neither is the performance sought considered acceptable, but rather as a step on the path towards the long-term goal. The core of the strategy is a set of key road safety performance objectives/indicators (KPIs) which reflect the key operational conditions affecting death and serious injury prevention and mitigation. These are directly and strongly related to the long-term goal and interim targets. For each KPI, key intervention options and institutional delivery mechanisms are set out. Following more detailed work by the Commission and Member States, the strategy envisages that targets will be set to ensure progress on each of these to 2030 to be announced in 2020.

4.3 Key elements of the strategy

4.3.1 The context for road safety in the European Union

The strategy should set out the context for road safety work in the EU.

- **The EU role in road safety:** The EU has clear competence to act within the broad multi-sectoral context needed to prevent death and mitigate serious injury in road collisions. The Treaty on the functioning of the European Union sets out the shared responsibility with its Member States for measures to improve transport safety (Article 91c).[70] In common with other shared activities, is guided by principles of subsidiarity and proportionality. (See Section 2.1).

- **External factors and emerging social and mobility trends:** A range of external factors and societal trends increase the road safety challenge to 2030 and beyond. The most notable are the continuing increases in GDP as economies continue to recover from the global financial crisis; the ageing road user population and its physical vulnerabilities; more travel by unprotected modes of walking and cycling vulnerable to death and serious injury risk; continuing popularity of the highest risk powered two-wheeler mode; the electrification of bicycles allowing higher speed; and the increased access to mobile, smart communication and information technologies within vehicles. While connected and autonomous vehicles are coming, though unlikely to be fully integrated before 2050, a safe path forward is not yet assured, and their safe performance is not yet demonstrated. Full account needs to be taken of these challenging developments within the developing road safety strategy to 2030 and beyond. (See Section 2.2).

- **Increasing ambition for better road safety results:** The heightened ambition for better road safety results expressed by the EU institutions requires a stronger, planned, systematic road safety approach at EU, national and local levels. The internationally recommended Safe System Towards Zero approach and performance framework represents the current best practice phase in road safety management. Here, road death and serious injury is acknowledged as

[70] Council of the European Union, 12 November 2012. 6655/7/08 Rev 7, Consolidated version of the Treaty on the functioning of the European Union, Brussels.

having an unacceptably high cost in humanitarian and socio-economic terms, but one known to be largely preventable. (See Section 2.3)

- **Increasing adoption of the Safe System approach:** While many countries globally are starting to work with this approach, its wide adoption is needed to provide more focus for professional efforts across EU countries to address road safety goals and targets. Its implementation will need to be supported by a range of EU activity including the setting of a new safety performance framework; greater use of EU funding and conditionality mechanisms, Safe System demonstration projects and guidance on Safe System implementation. Working towards the Safe System goal and approach are important developments and will require a substantial reorientation of road safety policy and practice over the next decades. It is widely acknowledged that it represents a major paradigm shift for road safety at EU level. The Commission will need to review its management capacity to fully implement a Safe System approach towards zero deaths and serious injuries. (Section 2.3).

- **Key safety performance indicators (KPIs):** The aspirational nature of long-term goals and targets set at EU level needs to be addressed by safety performance indicators which represent the underlying operational conditions underpinning fatal and serious injury prevention. This will enable closer and more focused safety management than allowed by addressing the long-term goals and interim targets alone by different levels of government and encourage multi-sectoral activity along demonstrably effective lines. (See Section 2.4).

- **Aligning road safety with other societal goals and objectives:** The aspirational nature of long-term goals and targets set at EU level also necessitates a broadening of scope of the road safety task and to galvanise shared responsibility for safety results. Road safety goals, targets and objectives need to be aligned with sustainable development goals to build even stronger business cases for road safety intervention. New inter-service coordination arrangements between Commission Directorates will be necessary. (See Section 2.5).

4.3.2 The current situation and future prospects

The strategy should set out the current road safety performance in the EU.

- **Progress to date towards the 2020 target:** Substantial progress has been made in reducing road deaths over the last two decades, aided by goal and target setting and strategy development. Between 2000 and 2017 there has been a 56% reduction in road deaths. EU leads the world in road safety and its performance is an international success story. However, the rate of road safety progress has slowed in recent years. Since 2010, a 20% reduction in deaths has been achieved to 2017 which makes meeting the 2020 target to reduce deaths by 50% highly challenging and now improbable. To achieve the road safety target for 2020, an annual reduction of 14.6% is required. Significant loss of life continues with 25,300 deaths in road crashes in 2017 and over 135,000 citizens sustaining serious injuries (to the common EU definition) annually. Each year, over 99% of total transport passenger deaths results from road crashes.[71] While the world's best road safety performers are to be found within EU countries, road safety performance is uneven across the

[71] European Commission (2017) EU Statistical Pocket Book, Brussels.

region and there is a threefold gap in road death rates between the better and worse road safety performers. Average mortality over the last three years varies between 27 and 94 road deaths per million population, with an average of 51 road deaths per million in EU28.[72] (See Section 3).

- **Overall assessment of the Policy Orientations strategy 2011-2017:** The 2015 study supporting the Commission's interim evaluation of the current strategy, as does this updated assessment, found considerable scope for the further development of EU road safety goals, targets and evidence-based strategy. There remains a large gap between the rate of progress desired by all the EU institutions to address preventable and unacceptable death and serious injury resulting from road collisions and current results. Much valuable activity has been conducted over the last two years to prepare for more effective intervention. Future progress depends upon a sharpening of focus, an inclusive delivery framework and broadening of scope to align with other societal objectives to scale-up capacity and investment. (See Section 3).

4.3.3 Road safety performance framework and related institutional delivery

The strategy should set out the EU long-term goals, 2030 targets and key performance indicators (towards eventual objectives) as well as leadership, related coordination arrangements and other institutional delivery.

Leadership, lead agency capacity and coordination

Political will and leadership of the shared responsibility for road safety is paramount for effective action and is expressed through high-level governmental leadership of road safety, strong Parliamentary support, the setting of and transparent accountability for long-term goals and quantitative targets supported by effective action with appropriate resource and management capacity.[73]

The EU is a global leader in road safety and the Commission has given itself the task of ensuring that this continues into the future. The Commission has pledged to make road safety a top transport priority to "Make sure that the EU is a world leader in safety and security of transport in all modes of transport."[74] Continuing leadership from the highest levels in the Commission will be fundamental to future successful activity.

DG MOVE and its road safety unit leads the European Commission's work on road safety and has responsibility for proposing goals and targets, developing overarching road safety strategies and action programmes and reporting on them. In common with national road safety lead bodies DG MOVE has some but not all key road safety responsibilities and a role of encouraging and guiding the efforts of the main agencies and players who can contribute to EU goals and targets. In order to provide the appropriate capacity for the implementation of next EU road safety steps, some strengthening is needed, particularly in any development of road safety strategy and targets, coordination, monitoring and evaluation functions and technical support.

There have been continuing calls by stakeholders for a European Road Safety Agency to be to set up in support of EU road safety strategy.[75] The European Transport Safety Council has suggested that such an agency could fulfil a number of support

[72] European Commission (2017). CaDaS, Brussels.
[73] First Global Inter-Ministerial Conference on Road Safety, Panel 2: Policy Frameworks: Summary, Nov 2009.
[74] European Commission (2011). White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system COM(2011) 144 final, Brussels, 28.3.2011.
[75] Summary of Florence Worksop High Level Symposium on Road Safety, 22nd January 2018.

roles such as the collection and analysis of crash-related data and exposure data; providing a catalyst for road safety information and data collection; and encouraging best practice across the EU (guidance in implementation Safe System provides one example). The preparation of an annual progress report in delivery of the 2030 road safety strategy to the EU institutions is a further example.

Road safety management capacity review is a tool recommended by the OECD, World Bank and World Road Association to all countries and jurisdictions in developing their strategies and plans. This could be a useful device for the Commission in assessing capacity and the function and form of any new institutional developments.

Commission coordination: a new Inter-Service Working Group on Road Safety

Reducing death and injury in road crashes is an issue which knows no borders and takes place in a complex, multi-sectoral context involving several levels of government and many actors. Responsibilities for a range of road safety intervention and activity cross a variety of Directorates including DG MOVE (common transport policy), DG GROW (Single Market vehicle safety legislation), DG SANTE (health sector surveillance of road traffic injury and public health), TEN-T agency INEA**:** (road network safety management), EU-OSHA (the European Agency for Safety and Health at Work; DG ELARG, DG REGIO (TAIEX and other initiatives); DG RESEARCH and INEA (road safety research). No stand-alone road safety coordination structure currently exists between directorates. New institutional arrangements for coordination at EU level will be necessary to ensure that road safety is treated as a core responsibility and better integrated into other areas of EU strategy, policy and budgets and to achieve co-benefits between road safety and other EU objectives. This would increase capacity for road safety through more effective business cases for important intervention and sharing of responsibility across Commission Directorates.

Leadership in road safety will also be vital in EU development policy to ensure that EU policy objectives apply to external aid and within the Neighbourhood Policy. Given that the EU is lead aid donor in international development, the Commission could fund Safe System 'learning by doing' road safety demonstration projects in external programming. In line with best practice, these might which simultaneously build institutional capacity, achieve quick road safety results in targeted high-volume/high risk corridor sections and areas through implementing multi-sectoral activities, lead to rapid exchange of knowledge and policy review.

High Level Group on Road Safety

The High-Level Group on Road Safety currently provides the main forum for discussion on the road safety efforts of Member States. The group has the potential to take on more activity and provides the ideal vehicle for coordination of Member States on measuring road safety objectives and targeting progress.

In 2015, the European Commission also established the High-Level Group (HLG) GEAR 2030 to coordinate automotive developments bringing together Member States' authorities and key stakeholders representing the industry, services, consumers and environmental protection and road safety.

European Parliament's Transport and Tourism Committee

In the European Parliament, the Transport and Tourism Committee generally takes the lead on road safety strategy matters and is well-informed by the Commission, Member States and a broad range of stakeholders representing business and civil society on road safety needs. Over the years, Chair of the Committee have played a key role in ensuring that road safety is an important part of the Parliamentary agenda.

A periodic report to Parliament and to the other EU institutions on the progress being made against new goals, targets and objectives is recommended.

City leadership

Leadership by mayors of cities and towns is also notable in many EU countries in efforts to improve the safety in urban and residential areas. The Commission might encourage Safe City demonstration projects or even a Safe City label to encourage Safe System approaches.

Top management of organisations

The leadership of top management in large and small organisations is also key to improving road safety. Employers have a key role to play across the EU given that around 40% of deaths are work-related. The ISO 39001 Road Traffic Safety Management System standard provides a useful tool for employers to demonstrate social responsibility in this field. The Commission and its agencies can play a key role in enhancing the priority given to this important sector.

With the aim of providing capacity for leadership, coordination and related delivery at the level of the EU institutions, it is recommended that the Commission, supported by the High-Level Group on Road Safety take the following steps:

Recommendations for EU action:

- Adopt a Safe System approach towards zero road deaths and serious injuries.
- Continue to provide road safety leadership at the highest level for Towards Zero.
- Review the Commission's road safety management capacity.
- Consider establishing a European Road Safety Agency as an executive arm.
- Set up a new Commission inter-directorate coordination group in support of the new road safety strategy and its goals, targets and objectives.
- Set up a Safe City challenge and label to encourage leadership and Safe System approaches at local level.
- Engage with the EU's leading employers to encourage new leadership and focus on road death and serious injury prevention.
- Engage with key stakeholders at EU level to encourage contribution to a range of measurable performance objectives, reporting in Annual Results Conferences.
- Create specific road safety funds in support of the measurement of key safety performance indicators, safer roads on the TEN-T and major roads, cross border enforcement and in international development and neighbourhood work in requiring conditionality in funding infrastructure projects, as well as funding of Safe System demonstration projects.
- Make implementing the Safe System approach across the EU the centrepiece of further research under Horizon 2020, the 9th Framework programme (F9) EU and earmarks funds for the next EU-road safety research budget line.
- Provide a periodic status report to the European Parliament on progress in achieving road safety goals, targets and objectives based on key performance indicators.
- Carry out a road safety management capacity to review lead agency capacity issues and readiness for action for new shared responsibility for road safety and co-benefits with other societal objectives e.g. occupational health and safety, industry, health, environment, across Commission Directorates (e.g. DG MOVE – several units including road safety (e.g. TEN-T, DG GROW, DG SANCO, OSHA) and with the High-Level Group on Road Safety) and to assist the further development of the strategy to 2030.

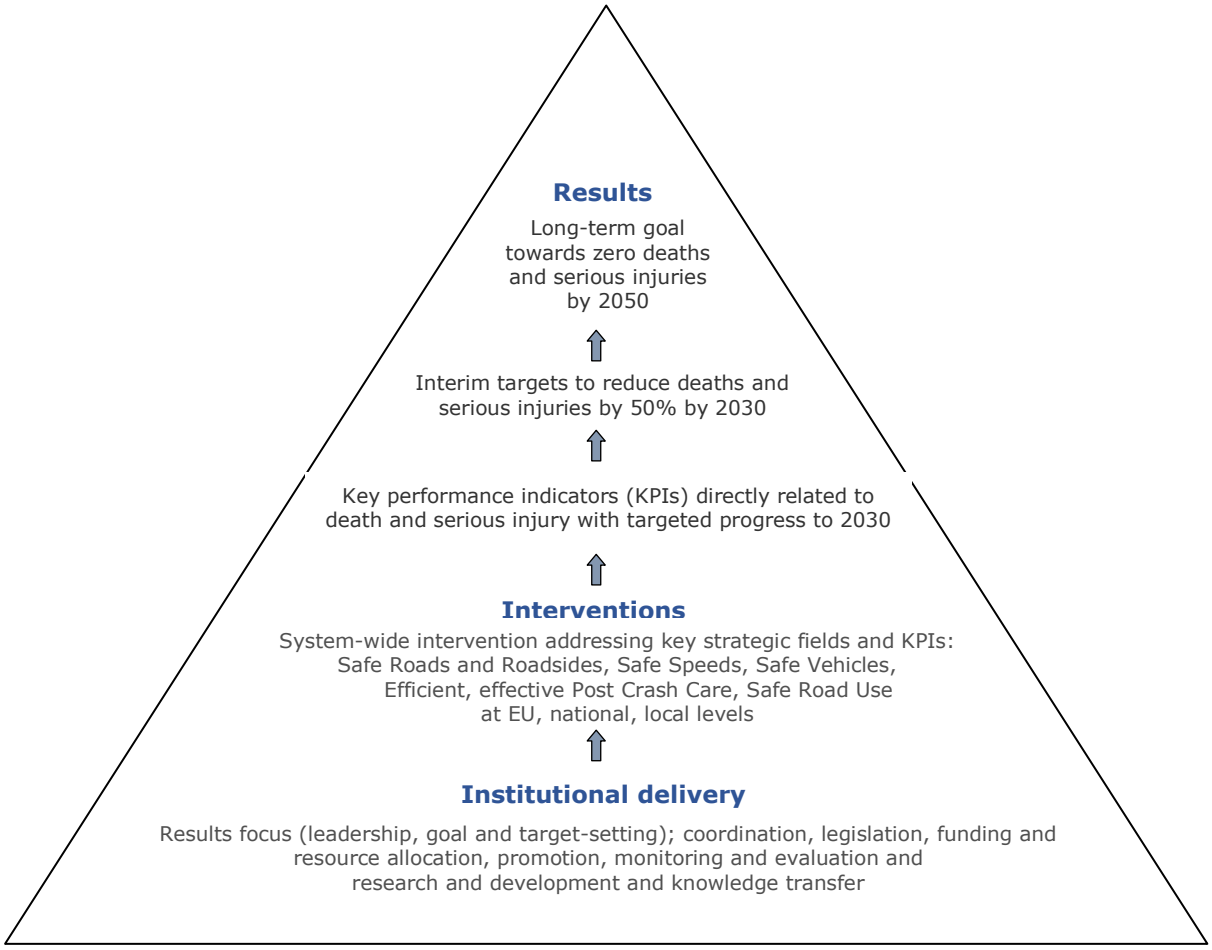
Recommendations for national action

- Adopt a Safe System approach towards zero road deaths and serious injuries.
- Ensure capacity in the national lead agency to prove national leadership for road safety goals, targets, objectives and strategy.
- Set up an expert advisory group and national champions to assist in the implementation of a Safe System approach.
- Review arrangements for national agency road safety coordination against good practice.
- Carry out a national road safety management capacity review and engage key agencies and stakeholder who can deliver road safety results.

Goals, targets and objectives

The core of the road safety strategy and the glue for multi-sectoral action is the setting of a safety performance framework for the 2030 strategy. A proposed framework is set out in Figure 8 which builds on the stated ambitions of the EU institutions. The different elements are discussed individually in the following sections.

Figure 8: Proposal for an EU Towards Zero road safety results framework



The World Health Organisation acknowledges that while trying to prevent the occurrence of all road crashes is unrealistic, death and serious injury is preventable. International organisations and experts recommend to all countries a road safety path towards the elimination of death and serious injury as a long-term aspiration. The aim is to work systematically, affordably, acceptably and for however long it takes on a

path towards roads and traffic which are eventually free from death and serious injury. In line with identified good practice, many low, middle and high-income countries and cities are adopting these goals, supported by measurable targets and system-wide strategies in programmes and projects.

In 2011, the European Union was the first jurisdiction to set a time limit for the achievement of the long-term aspiration of prevent death in road traffic crashes. The goal is to move close to zero fatalities in road transport by 2050 – a Vision Zero (or Safe System as it is known generically) for EU road safety activity. In line with a Safe System approach, the strategy should extend the long-term goal to include serious injuries based on the common definition agreed in 2014.[76]

With the aim of providing an aspirational long-term Safe System goal to inspire ambitious approaches to road safety at EU and national levels, it is recommended that the Commission takes the following steps:

Recommendations for EU action:

- Extend the current long-term goal to include a separate goal for serious injury:
  - By 2050 move close to zero fatalities in road transport
  - By 2050 move close to zero serious injuries in road transport.

Recommendation for national action:

- Adopt a long-term goal towards the ultimate prevention of death and serious injury in road crashes.

Interim targets to reduce death and serious injury: 2020-2030 (final outcomes)

Setting challenging, step-wise quantitative final and intermediate outcome and output targets towards the goal of virtually eliminating death and long-term injury is recommended as effective practice. Targets drive decisions about countermeasures, their coordination needs, legislative needs, funding and resource allocation requirements, promotion needs, as well as requirements for monitoring and evaluation, research, development and knowledge transfer. Quantitative targets lead to better programmes, more effective use of public resources and an improvement in road safety performance.[77] Research shows that ambitious targets are associated with better performance than less ambitious targets. [78] [79]

The first EU target of a 50% reduction in road deaths between 2001 and 2010 helped to achieve a large 43% reduction in deaths. Countries such as Lithuania, Latvia, Spain, Portugal, Estonia, Slovakia all achieved reductions in deaths of more than 60% since 2001. The ambitious 2001 and 2011 targets helped to mobilise effective action at local, national and EU levels. While the current target will not be met, EU targets for road deaths have played a key role in assisting national road safety management.

[76] The common definition of 'serious injury' includes all road traffic crash victims with a MAIS score of at least three (i.e. a MAIS score of three, four, five or six). Traditionally for the purposes of the CARE database, "serious injury" has been defined as an injury that requires 24 hours or more of hospital care. As this definition has led to imprecision in reporting, Member States have agreed to start collecting injury data based on the new definition.

[77] OECD (1994) Targeted Road Safety Programmes, Paris.

[78] Allsop RE, Sze NN Wong SC (2011). An update on the association between setting quantified road safety targets and road fatality reduction, Accident Analysis and Prevention 43 (2011) 1279–1283.

[79] Elvik R. (2001). Quantified road safety targets: An assessment of evaluation methodology. Report 539. Institute of Transport Economics, Oslo.

Less progress has been made in addressing serious road injuries. No targets have yet been set at EU level, although the EU institutions are supportive. The Transport White Paper envisaged the setting of a quantitative target to reduce road injuries. The European Parliament has called for an additional target to reduce serious injuries. The recent Valetta Declaration from Transport Ministers called for new targets to reduce deaths and serious injuries by 50% by 2030 (2020 baseline) and in the framework of an overall road safety strategy for this period.[80] The Commission has drawn attention to the importance of addressing serious road traffic injuries at EU level which are many more numerous than road deaths and lead to unnecessary human suffering and societal cost to victims and their families, the health sector and employers. A valuable Policy Orientations initiative has been undertaken to harmonise the definition of serious injury which now allows the setting of a common serious injury target.

A closer focus on the prevention and mitigation of death and serious injury (as opposed to interventions targeting crash prevention in general) supported by demonstrably effective intervention and enhanced institutional delivery is clearly needed and is addressed in the new strategy. Future intervention needs to be shaped by 2050 and 2030 goals, targets and objectives. The four largest countries define 50% of all deaths – France, Italy, Germany and Poland. The efforts of the eight EU countries with the highest populations which contribute 75% of the death and serious injury burden will be highly important.

Good practice in Safe System implementation indicates that final outcome targets are simply expressed; covered a defined period, usually 10 years; are confined to a reduction in the number of deaths and serious injuries and avoiding the temptation to disaggregate to specific casualty groups or to express targets as rates.

At the same time, and as in the past, overarching long-term EU 28 road safety goals and interim targets are necessarily aspirational rather than empirical in nature, given the complexities of the multi-sectoral road safety task, the lack of comprehensive safety performance and exposure data and the range of actors involved. While the baseline for 2020 is as yet unknown, this should not prevent a target being announced in advance.

With the aim of providing interim, targets for the reduction of death and serious injury, it is recommended that the Commission takes the following steps:

Recommendations for EU action:

- Set a new interim target to reduce the number of deaths by 50% by 2030 (2020 baseline).
- Set a new interim target to reduce the number of serious injuries by 50% by 2030 (2020 baseline).

Recommendation for national action:

- Set new interim targets to 2030 to reduce the number of a) deaths and b) serious injuries in road crashes.

Proposed set of EU key safety performance indicators (KPIs, intermediate outcomes)

Against these highly ambitious aspirational goals and targets, closer management of road safety performance, intervention and delivery is required at EU, national and

[80] Valletta Declaration on Improving Road Safety. (2017)

local levels. It requires a 'managing by objectives approach' which relies on measurement, targeting and monitoring of key activity in key safety performance fields with a known probability of delivering results.

In addition to long-term goals and interim targets, a Safe System/Towards Zero performance framework involves addressing the operational conditions across the road traffic system which underpin better road safety performance, and which directly relate to goals and targets for the prevention and mitigation of death and serious injury. This approach is highly recommended as international best practice by the World Health Organisation, OECD, World Bank, International Standards Organisation, World Road Association and other organisations and countries are increasingly working with these factors in Europe and further afield.

The following set of strategic fields with an initial set of key measurable safety performance indicators (KPIs) is proposed.

- Increasing the safety quality of roads and roadsides
- Improving levels of safe travel speeds
- Increasing the safety quality of new vehicles
- Increasing the efficiency and effectiveness of post-crash care
- Increasing levels of safe road use (use of seat belts, child restraints, crash helmets; driving without alcohol or other drugs); driving without distraction.

The core of the strategy comprises a set of key EU safety performance indicators within these strategic field which are outlined in Table 7. While these are for voluntary take up by Member States, there is broad acknowledgement that the use of KPIs represents a good way forward and it is expected that there will be general take-up as far as possible.

Analysis has been conducted by SWOV for this preparatory work with supporting data provided by Euro RAP and Euro NCAP. The general methodology used in the analysis and a summary of results and main assumptions are provided in Annex 2. The KPIs have been selected on the basis that they:

- directly relate to the prevention and mitigation of death and serious injury and thereby related to long-term and interim goals and targets;
- directly specify the operational conditions underlying death and serious injury outcomes rather than deaths and serious injuries;
- address the key problems of all road users;
- support the Safe System approach;
- are for voluntary take-up nationally, although general take-up is expected;
- are feasible, albeit new to some, and at a reasonable cost for administrations;
- are monitored and reviewed periodically (every 2 to 3 years depending on the circumstances and ease of measurement).

The proposed indicators have a direct and demonstrated relationship with preventing or mitigating fatal and serious injury and, in most cases, are based on cautious assumptions. In many cases, the quantity and quality of existing data only allow best estimates rather than 'set in stone' estimates of potential casualty reduction effects. The proposed indicators do not cover all road safety issues which need to be addressed. Examples include the range of vehicle safety measures which will be presented in the revision of the General Safety Regulation and Pedestrian Safety Regulations which may go beyond those covered by the indicator. New casualty reduction potential around driver licensing standards which are not covered by indicators are a further example.

The results of the KPI analysis shown in Table 7 demonstrate that a very substantial reduction in death is possible given current knowledge and that aspirational goals and targets can be underpinned to a reasonable extent by action in key fields.

Table 7: Proposed set of EU key safety performance indicators

Strategic field	*Key safety performance indicator (KPI)*	*Potential lives saved to 2030to 2030*	*Potential serious injuries saved to 2030*
Safe Roads & Roadsides	Proportion of traffic volume on the comprehensive TEN-T network and other roads of strategic importance with a 3-star or better Euro RAP rating	2029 [81]	6083
Safe Speeds	Proportion of traffic volume with drivers travelling within the speed limit on urban roads, rural roads, motorways, TEN-T network. Proportion of traffic volume on urban, rural, motorways, TEN-T roads within speed limits which are 'safe and credible'.	6489 not assessed	19720 not assessed
Safe Vehicles	Proportion of new passenger cars with a 5* Euro NCAP rating.	3295	6590
Efficient access to EMS	Proportion of crash victims with access to professional medical assistance within 15 minutes.	2600	7992
Safe Road Use	Proportion of motor vehicle occupants using a seat belt in a) front seats and b) rear seats	905	1849
	Proportion of correct use of child restraints by child occupants	31	68
	Proportion of a) motorcyclists and b) moped users and c) pedal cyclists with correct use of a protective helmet.	202 740	1196 2220
	Proportion of drivers and riders of motorised vehicles without alcohol or other drugs which impair driving.	3379 Alcohol effect only	10269 Alcohol effect only
	Proportion of drivers without use of in-car telephones.	1817	5522

The combined result of the potential effects shown in Table 7 indicate very roughly that over 12412 deaths and 37904 serious injuries (MAIS 3+) might be prevented by 2030 if all KPIs reach a level of 100%. This would mean nearly a 50% (49.45%) reduction in deaths compared to the provisional 2017 level. Estimates for the savings in severe injury to the common definition far exceed the fatality saving potential. The 2030 estimate is based on the current values of KPIs (except that for the vehicle KPI) and corrects for the safety effect overlap of the different KPIs. The estimate excludes additional effects from other safety measures possible outside the KPIs such as substantial future savings expected from EU legislative action on vehicle safety and further, future enhancements of Euro NCAP protocols. Neither does the estimate include the effects of comprehensive road infrastructure indicators beyond those for the comprehensive TEN-T network or the impact of safe and credible speed limits.

The addition of a KPI framework to EU road safety strategy is likely to result in enhanced focus and closer management of road safety progress at EU level and provide encouragement to professionals and policymakers for work carried out nationally. The framework will provide for a deepening of focus on the prevention of

[81] Estimate provided by Euro RAP, January 2018 and includes Comprehensive TEN-T roads only.

death and serious injury as well as a broadening of the meaningful shared responsibility needed for the successful delivery of effective intervention.

Further technical work by road safety experts and Member States will be needed regarding further definition, measurement protocols and guidance and reporting of key road safety performance indicators. It is envisaged that a basic set of uniform EU indicators will not preclude Member States from setting their own additional KPIs to address issues of further national importance.

Experience shows that Annual Results Conferences can provide an innovative way of encouraging appropriate focus on strategy goals, targets and objectives, declared contributions and exchange of best practice and accountability for results from key agencies and the wider road safety stakeholder partnership.

With the aim of embedding the Safe System approach in EU road safety policy and addressing the key operational conditions which influence road safety outcomes, it is recommended that the Commission and Member States take the following steps:

Recommendations for EU action:

- Set key EU road safety performance indicators (KPIs) which are directly to the prevention and mitigation of death and serious injury in road crashes.
- Establish common measurement methodologies based on Safety Net Project recommendations and baselines to allow an EU data set and national comparisons.
- Establish a road safety metrics fund to provide incentive and assistance to Member States in collecting KPI data.
- Set up an expert advisory group comprising recognised experts to assist the Commission on strategic and KPI issues.
- Request Member States to collect baseline data for each indicator and to set up a working group within the High-Level Group on Road Safety/CARE expert group.
- Commence work with Member States to establish 2030 measurable KPIs and verifiable KPI targets for EU road safety using the KPIs announced in 2018 (to be announced by December 2019).
- Engage the newly established Commission inter-service coordination body in the adoption of a limited set of 2030 KPI objectives.
- Host Annual Results Conferences post-2020 for agencies and stakeholders to review progress against key performance objectives.

Recommendations for national action:

- Adopt, measure, target, monitor and report progress on a set of KPIs which are directly to the prevention and mitigation of death and serious injury in road crashes.
- Engage in coordinated activity of the HLG, national road safety expert groups and in EU Annual Results Conferences of road safety progress against goals, targets and objectives.
- Set up national Annual Results Conferences to review progress against key performance objectives.

The following sections present the justification in outline for each safety performance indicator in terms of its casualty reduction potential (best estimates only); examples of interventions at EU and national levels needed to address the indicator and any new institutional delivery mechanisms and actions which underpin the delivery of better

outcomes: coordination, funding and resource allocation (including public procurement), legislation, promotion, monitoring and evaluation and research and development and knowledge transfer. Further information on the assessment methodologies used is provided in Annex 2.

Increasing the safety quality of roads and roadsides

Introduction

The planning, design and operation of roads and roadsides is a key Safe System strategy. The aim is to support correct road use in the form of 'self-explaining' roads and 'forgiving roadsides' such that if crashes occur, they do not lead to death and serious injury.

In-depth crash injury research has shown that road-related factors are very strongly linked to fatal and serious injury causation in road collisions. In-depth research indicates that injury outcomes in car crashes, irrespective of severity, are mostly related to an interaction between three components: the road, the vehicle, and the road user.[82] However, the significance of the components differs depending on crash severity. The safety quality of the *vehicle* is the most important component to reduce serious injury outcomes and injuries leading to permanent medical impairment. In fatal crashes, improvements to the *road* would yield the highest potential for further reductions of car occupant injuries with road factors most often linked to fatal outcomes in 63% of cases.

Assessing the current safety quality of the roads and roadsides

The International Road Assessment Programme (iRAP) and EuroRAP risk mapping and star rating tool provides an excellent example of a widely-used tool which can be used measure and target progress in improving the safety quality of roads and roadsides. EuroRAP carries out road assessment programmes on major roads across many EU Member States, though the amount of assessment needs to be substantially increased. The aim is to providing evidence-based safety ratings of the assessed roads to benchmark crash and infrastructure risk differentiated for pedestrians, cyclists, motorcyclists and car occupants. The aim is to provide objective data to inform investment priorities and track performance over time. The safety ratings range between 1-star, the lowest safety rating and 5-stars, the highest.

The current safety quality of the roads and roadsides

TEN-T network

This network comprises major European roads (primarily motorways and national/main roads) defined in the TEN-T Guidelines. A distinction is made between the core network and the comprehensive network, which also includes connecting roads. While the comprehensive TEN-T network comprises only around 4% of the total network (excluding urban roads), it contributes a disproportionate 11% of deaths. Overall, around 80% of travel is estimated as achieving a 3-star or better rating. However, more than 50% of travel on the network in eastern EU countries is below this safety level with users experiencing 3 times the level of serious and fatal crash injury risk. An updated Risk Map for the comprehensive TEN-T is needed.[83]

[82] Stigson H, Kullgren A and Krafft M, (*2011) Use of Car Crashes Resulting in Injuries to Identify System Weaknesses*, *Paper* presented at the 22nd International Technical Conference on the Enhanced Safety of Vehicles (*ESV*). Washington DC, USA. DOT/NHTSA http://www-nrd.nhtsa.dot.gov/pdf/*esv*/esv22/22ESV-000338.pdf

[83] Unpublished Euro RAP assessments, 2017.

Table 8: Safety performance of the comprehensive TEN T network

	Western EU	Eastern EU
Length of roads (km)	105,034	41,563
Annual Deaths	1,804	1,008
Travel on 1- and 2-star roads	13%	56%
Deaths on 1- and 2-star roads	29%	81%

Source: EuroRAP, 2017

National roads

The vast majority of deaths (89%) on inter-urban roads is estimated to occur on national and local roads. Based on a sample of eight Member States the distribution of fatalities by road type on the inter-urban road network in EU countries, the majority occur on motorways and primary roads (39%) and 28% on secondary roads and 24% on local roads. [84]

Relationship with the prevention and mitigation of death and serious injury

Various analyses by iRAP members in different countries indicate that for every increase in iRAP star rating, substantial reductions in fatal and serious crashes are achieved.[85] [86] One study indicated that each increase in star rating resulted in a halving of fatal and serious injury can be anticipated.[87] The OECD notes that the risk (the number of deaths or serious injuries per km travelled) on a 5-star road is approximately 10% of the risk on a 1-star rated road.[88]

Barrier treatments, well-designed roundabouts and traffic calming treatments can produce reductions in serious and fatal injuries of 80% or more.[89]

Key safety performance indicator

Proportion of traffic volume on the comprehensive TEN-T network and other roads of strategic importance with 3-star or better Euro RAP rating.

Use of this rating as a key safety performance indicator is recommended by several international organisations working in road safety such as the ITF/OECD, the World Road Association and the European Transport Safety Council and is adopted for networks in countries with leading road safety performance. [88] [90] [91]

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[84] European Commission, Impact assessment on revision to the infrastructure directive SWD (unpublished).

[85] Brodie C, Waibl G and Tate F. See:http://acrs.org.au/files/arsrpe/Waibl%20et%20al%20%20The%20Development%20of%20a%20Proactive%20Road%20Safety%20Assessment%20Tool%20KiwiRAP.pdf

[86] Lawson, S. Crash rate-star rating comparisons: review of available evidence May 2011, http://resources.irap.org/Research/2011%20iRAP%20report%20-%20crash%20rate-star%20rating%20comparison%20paper.pdf accessed 14.3.18

[87] McInerney R and Fletcher M (2013) Relationship between Star Ratings and crash cost per kilometre travelled: the Bruce Highway http://www.irap.net/en/about-irap-3/research-and-technical-papers?download=91:relationship-between- star-ratings-and-crash-costs-the-bruce-highway-australia, accessed 6.1.18.

[88] OECD/International Transport Forum (2016), Zero Road Deaths and Serious Injuries: Leading a paradigm shift to a Safe System OECD Publishing, Paris.

[89] EuroRAP (2011) Crash rate -Star Rating comparisons: Review of available evidence, May 2011, iRAP/ EuroRAP Working Paper 504.2, Basingstoke.

[90] World Road Association (PIARC) (2015). Road Safety Manual: A manual for practitioners and decision makers on implementing safe system infrastructure, World Road Congress (PIARC), Paris. https://roadsafety.piarc.org/en/introduction

Safety effects

A rough estimate has been provided by Euro RAP for the comprehensive TEN T network. EuroRAP analysis indicates that if 100% travel is achieved on 3-star roads on the TEN-T comprehensive network (core network plus connecting roads) the fatality saving might be 864 per year (of the total 2812 killed). If all travel (100%) is achieved on 4-star roads all TEN-T comprehensive network, then some 2029 lives might be saved annually. This latter estimate is used.

Alignment with other societal objectives

This indicator aligns particularly well and shares co-benefits with:

- public health objectives to reduce death and serious injury;
- sustainable transport, urban transport and active travel objectives;
- environmental objectives to minimise high speeds to reduce emissions;
- occupational health and safety objectives for work-related road safety;
- functioning of internal market and economic, social and territorial cohesion objectives.

Key intervention priorities and institutional delivery

Revision of the Infrastructure Directive (2008/96)

The EU has had a strong focus on road infrastructure safety management (RISM) in EU road safety policy since the adoption of the White Paper on Transport policy in 2001. The current EU legislation covers roads and tunnels within the Trans-European Transport Network (TEN-T). The aim of harmonised action is convergence towards higher standards of infrastructure safety across the EU, whereby less well performing countries will be able to benefit from the experience of more advanced countries.

The RISM Directive (2008/96/EC) defines guidelines and best practices without imposing specific technical standards or measures on Member States. The main management instruments are road safety impact assessments (strategic analysis at the planning stage), road safety audits (from design to early operation), road network safety management (regular safety ranking and follow-up at accident prone locations) and safety inspections (periodic checks). The Tunnel Directive (2004/54/EC) requires Member State authorities to take safety measures in existing TEN-T tunnels, to clearly allocate responsibilities amongst entities involved, to improve tunnel safety management procedures (e.g. periodic inspections), and to design and manage new tunnels to at least a common minimum standard.

In the Valetta Declaration, Transport Ministers committed, among other things, to improving "the safety of road users by developing safer infrastructure, bearing in mind the possibility of extending the application of infrastructure safety management principles beyond the Trans-European Transport Network (TEN-T) roads".

The Commission is working on a revision to the RISM Directive with several objectives. These are to foster harmonisation and knowledge sharing between Member States on road infrastructure safety management procedures; to protect vulnerable road users; to improve the deployment of new technologies on EU road networks to future-proof the legislation and facilitate the roll-out of connected and automated mobility systems; and, finally to improve the follow-up on findings of road infrastructure safety management procedures. The expected instruments include the monitoring of the safety level across TEN-T, the inclusion of a performance target in the next revision of TEN-T guidelines and the possibility to support road safety upgrades through Community funds such as via the Multiannual Financial Framework.

[91] ETSC (2018). Briefing:5th EU Road Safety Action Programme 2020-2030 February 2018

The Commission notes that the preferred policy option selected from the impact assessment includes elements of the Safe System approach. It would require network-wide safety assessments on the TEN-T and also to Member States' primary road networks. However, Member States would retain flexibility to set the desired level of road infrastructure safety. The choice of appropriate technical solutions would also remain with Member States with EU legislation only setting minimum performance requirements where required by the smooth roll-out of CCAM. The impact assessment concluded that the proposal, if and when fully implemented has the potential to save approximately 14,650 lives and 97,502 serious injuries to 2050 and 562 lives and 3,675 serious injuries in 2030 compared to the baseline.

Creation of a Safer Roads Fund/ financial incentives within the Multiannual Financial Framework (MFF)

Typically, most deaths in road traffic crashes occur on a small proportion of roads where traffic volumes are high, speeds are high and where there is a wide range of high speed and lower speed traffic. Such roads usually have both urban and rural sections. These roads have high strategic priority, attract large investment, and are particularly amenable to targeted road safety treatments. Design standards at junctions and the management of road use from low- to high-speed environments expect vulnerable road users to compete successfully against faster, bigger vehicles, often with tragic consequences.

There is an opportunity for a scaling-up of highly cost-effective targeted EU investment on the TEN-T and other roads, particularly on the Eastern part of the network. This could be achieved through the creation of a Safer Roads Fund or other financial incentive provision within the Multiannual Financial Framework (MFF) and road infrastructure management policy.

A two-phase initial safety investment programme over 7 years to 2025 has been proposed by Euro RAP.[92] The first phase proposed is to target all 1- and 2-Star roads on the comprehensive TEN-T network with rapid, lower cost 'maintenance type' measures which deliver high returns. The total length of network proposed to be targeted in the first phase is 28% of the total (40,000km) of which 16,000km is in the Western EU and 24,000 km in the East. It is estimated that a first phase investment of €4.3billion (thousand million). (€600m per year) would save more than 100,000 deaths and serious injuries over its economic life with benefits of more than €20 billion. This single initiative is estimated to reduce annual EU deaths by 500 by 2025 and the network total by 15%. A second phase of investment is proposed beginning in 2020. This phase aims to begin to raise the level on the comprehensive TEN-T towards the norm achieved on the best national networks. A provision of €3 billion and hurdle benefit-cost ratio of 3 is proposed for this second phase. The investment total proposed of €7.3 billion over the 7-year period is estimated to deliver benefits valued at €28 billion and 170,000-190,000 deaths and serious injuries saved over its economic life.

Specific allocation of funds for cycling and pedestrian safety within the Connecting Europe Facility (CEF).

Specific allocation of funds for cycling and pedestrian safety might be provided within the Connecting Europe Facility (CEF). *Safe Town* or *Safe City* projects can provide opportunities for effective multi-sectoral working and help develop safety management across urban planning, public transport, safety engineering, health, police and education sectors and reach ambitious targeted road safety results. They tend to

[92] Euro RAP (2017). Unpublished document provided to this study. Estimating an Infrastructure Safety Budget for the Comprehensive TEN-T.

attract great public support, especially with mayoral and cross-party engagement.[93] A Safe City labelling programme might also be created with funding from such a source. Such activity would be in line with Commission urban transport policies and road safety policies. Demonstration projects will bring added value and results in centres of large population.

Recommendations for EU action:

- Adopt KPI on the proportion of the comprehensive TEN-T network and other roads of strategic importance with 3-star or better Euro RAP rating.
- Work with Member States to monitor and target progress on this to 2030.
- Support the collection and reporting of traffic volume by mode on all road types.
- Extend the Infrastructure Directive (2008/96) to national main roads and 2) embed elements of a Safe System approach such as mandatory, measurable network-wide safety assessments and minimum performance requirements for certain road infrastructure components to facilitate the smooth roll-out of cooperative, connected and automated mobility.
- Commission an updated Risk Map for the comprehensive TEN-T.
- Encourage knowledge transfer and the adoption of the Safe System approach to road safety engineering on the TEN-T and the secondary network.
- Carry out work to establish a TEN-T road classification which matches speed limits to the road design and layout in line with a Safe System approach.
- Create a Safer Roads Fund or other incentive framework within the Multiannual Financial Framework (MFF) to provide targeted road safety investment on high-risk/high-volume roads on the TEN/T network in line with the Safe System approach.
- Ensure that regional funds for roads are conditional on the use of measurable safety assessment using demonstrably effective tools and identified improvements in infrastructure safety.
- Specifically allocate funds for cycling and pedestrian safety within the Connecting Europe Facility (CEF).
- Promote and fund Safe Corridor and Safe City/Safe *Town* projects on the TEN-T and secondary network comprising road safety engineering and multi-sectoral intervention to achieve results and develop road safety management capacity.

Recommendations for national action:

- Adopt, measure, target, monitor and report progress on KPIs for increasing the safety quality of roads and roadsides on the TEN/T and other roads.
- Adopt a maximum of 30 km/h in residential areas and areas where there are existing or expected high levels of cyclists and pedestrians.

Improving levels of safe travel speeds

Introduction

Speed and its management is central to designing and implementing a *Safe System* approach and cuts across most Safe System intervention categories and sectoral activity. Studies show that for both urban and rural roads, small differences in speed can have a large effect on the occurrence and severity of road crashes and their

[93] EU DUMAS Project (Developing Urban Management and Safety) (2001). Final Project Report.

outcomes.[94] [95] [96] The chances of survival for an unprotected pedestrian hit by a vehicle diminish rapidly at speeds greater than 30km/h, whereas for a properly restrained motor vehicle occupant the critical threshold for death and serious injury is 50km/h (for side impact crashes) and 70km/h (for head-on crashes).[97] In depth studies in Britain show that approximately half of pedestrian fatalities occur at or below 50km/h and for pedestrians in impacts with car fronts, the risk of death rises rapidly (4.5 times from 50km/h to 65km/h). [98] As noted by the OECD, other studies indicate both higher and lower thresholds [99]. The threshold for serious injury will be lower. These are not necessarily safe speed limits per se but indicate thresholds which need to be taken into consideration in network safety management in weighing up options for treatments.

The aim of speed management on the network is to match allowable speeds with road function taking full account of the protective qualities of roads, roadsides and vehicles and assisting drivers and riders in achieving safe speeds. On this basis, safe travel speeds have been identified for different urban and rural road types taking into account human tolerance thresholds and the protective quality of roads, roadsides and vehicle design.[97] (See Table 9 below).

This means that in residential areas and on other roads where pedestrians and cyclists are mixed with cars and trucks, speeds should be limited to around 30km/h, and roads should be designed to facilitate these speeds (but no higher speeds). This can be done by using speed humps, chicanes and other road components. Many urban roads cannot be designed as a residential 30km/h speed road, for obvious reasons of high urban traffic volumes and travel times. In many cities, we see 50 km/h roads in use for this intermediate road function. This function requires that pedestrians and cyclists are separated from cars and trucks, and that speeds are effectively limited to 50km/h. This is especially relevant at intersections.

Table 9: Types of road infrastructure and traffic and safe speed

Types of road infrastructure and traffic	*Safe speed (km/h)*
Locations with possible conflicts between cars and pedestrians/cyclists	**30**
Junctions with possible car-to-car side impacts	**50**
Roads with possible car-to-car frontal impacts	**70**
Roads with no possibility of side impact or frontal impact	**>100**

Source: Tingvall C and N Haworth (1999)

[94] Nilsson G. (2004) Traffic safety dimensions and the power model to describe the effect of speed on safety. Bulletin 221, Lund Institute of Technology, Lund

[95] Elvik R, Christensen P, Amundsen A, (2004) Speed and Road Accidents, an evaluation of the Power Model, TOI, Oslo.

[96] Taylor MC, D A Lynam DA and A Baruya (2000) The effects of drivers' speed on the frequency of road accidents, TRL Report 421, Crowthorne.

[97] Tingvall C and N Haworth (1999). Vision Zero - An ethical approach to safety and mobility. Paper presented to the 6th ITE International Conference Road Safety & Traffic Enforcement: Beyond 2000, Melbourne.

[98] Richards D. C. (2010). Relationship between Speed and Risk of Fatal Injury: Pedestrians and Car Occupants, Transport Research Laboratory, RoadSafetyWebPublicationNo.16, DfT, London.

[99] OECD/International Transport Forum (2016), Zero Road Deaths and Serious Injuries: Leading a paradigm shift to a Safe System OECD Publishing, Paris.

Rural roads that cannot be designed as motorways (i.e. no level crossings, separate carriageways or non-motorised use), should be designed to facilitate a maximum speed of 70km/h. In many countries the speed limit usually is 80km/h or 90km/h, which means frontal crashes can lead to more fatal injuries more often that theoretically necessary. Motorways should be designed to safely facilitate these speed, such that no frontal or side impact crashes are possible, nor crashes with trees, poles or concrete structures in run-off collisions.

The allowable speeds of much of the road network in EU countries are higher than the protective quality of road, roadside and vehicle design allows. Most urban limits are set at 50km/h and some are at 60km/h. Within these lower limits of 30km/h are often set for urban residential roads and shopping streets. Speed limits outside built-up areas range between 70 km/h and 110 km/h on non-motorway roads. The leading performers in Europe (Norway and Sweden) have limits of 70 and 80 on these roads and 100km/h and 110km/h on motorways. On motorways, the range is between 80kmh and 140km/h, with most at 120km/h or 130 km/h.[100]

Surveys indicate that non-compliance with posted speed limits is widespread. A substantial proportion of drivers exceed the speed limit in all EU countries – between 50% and 85% on urban roads, between 50% and 91% on rural roads and between 57% and 84% on motorways.[101]

Two sets of key safety performance indicators for improving levels of safe travel speed are proposed.

Key safety performance indicators

Indicators

Proportion of traffic volume with drivers travelling within the speed limit on urban roads, rural roads, motorways, TEN-T network.

This KPI addresses speeds travelled by drivers of all motorised vehicles. It is recommended that observational studies of actual speeds in normal traffic are used for this indicator rather than self-reporting methodologies.

Proportion of traffic volume on urban, rural, motorways, TEN-T roads within speed limits which are 'safe and credible'.

This KPI addresses road authorities rather than road users. it recognises that many speed limits are too high when it comes to implementing a Safe System approach and allow higher speeds than provided by the existing protective qualities of roads, roadsides and vehicles. Work will need to be carried out to define safe and credible speed limits according to the Safe System approach. On urban roads, for example, it would imply that access roads (direct access to front doors, shops, schools etc.) have a design that enforces low speeds (<30km/h) through speed humps etcetera. Higher volume 50km/h roads would have to be designed so as to physically prevent crossings anywhere, except at safe pedestrian crossing locations, and intersections that prevent speeds above 50 km/h etc). A discussion on 'safe and credible speeds' can be found in Aarts et al (2009).[102]

[100] European Commission (2017) EU Statistical Pocket Book, Brussels.

[101] Yannis G, Laiou A, Theofilatos A, Dargmanovits A (2016). Speeding. ERSA thematic report 1, ERSA project, Athens.

[102] Aarts, L., Nes, N. van, Wegman, F., Schagen, I. van & Louwerse, R. (2009) Safe speeds and credible speed limits (SaCredSpeed): A new vision for decision making on speed management. Compendium of

Safety effect

For the first indicator, if all drivers complied with existing motorway speed limits, it is roughly estimated that at around 686 lives would be saved. If all road types are included a very rough estimated is that around 6489 lives might be saved.

An estimate for the safety effect of the second proposed indicator relating to safe and credible speed limits is not assessed.

Alignment with other societal objectives

This indicator aligns particularly well and shares co-benefits with:

- public health objectives to reduce death and serious injury;
- sustainable transport, urban transport and active travel objectives;
- environmental objectives to minimise high speeds to reduce emissions;
- occupational health and safety objectives for work related road safety.

Relationship with the prevention and mitigation of death and serious injury

Research indicates that 1km/h decrease in average speed corresponds with a 2% decrease in injury crashes, a 3% decrease in serious injury crashes and a 4% to 5% decrease in fatal crashes and vice versa.[103] [104] The World Health Organisaiton estimates that a 5km/h decrease in mean speed could lead to a 30% reduction in fatal injuries.[105]

Key intervention priorities and institutional delivery

Road classification and speed limit hierarchy

Modern approaches to establishing a speed classification for the national network involves establishing clear urban and rural road hierarchies which better match function to speed limit and layout and design; separating oncoming traffic on high-volume, high-speed roads to prevent head-on collisions and providing crash protective roadsides to address run-off road collisions; ensuring safe speeds at intersections to reduce fatal and serious side collisions and ensuring safe speeds on roads and streets with dangerous mixed used where separation of motor vehicles and vulnerable road users may be difficult.[106]

Road classifications and road speed limits are generally decided nationally. With the growth of EU membership over the last two decades there is less convergence in speed limits than previously, as outlined in the previous section. Few countries have revised road classifications in line with *Safe System* principles. Re-classifying the network to take better account of injury tolerance at different speeds was one of the first actions of countries in the Netherlands and in Sweden in implementing a Safe System approach.

The iRAP tool provides a useful mechanism and takes speed limits into account in assessing the inherent risks in roads and in its star rating system.

papers of the 88th Annual Meeting of the Transportation Research Board TRB, Washington, D.C., 11-15 January 2009. http://saiv.espaceweb.usherbrooke.ca/References/319_2009_SaCredSpeed_15p.pdf

[103] Nilsson G (2004) Traffic safety dimensions and the power model to describe the effect of speed on safety. Bulletin 221, Lund Institute of Technology, Lund

[104] Elvik R, Christensen P, Amundsen A, (2004) Speed and Road Accidents, an evaluation of the Power Model, TOI, Oslo.

[105] World Health Organisation (2017).

[106] UNRSC (2012). Safe roads for development: a policy framework for safe infrastructure on major road transport networks, Geneva.

In-vehicle driver assistance

Intelligent speed assistance is an important means to improving levels of safe speed. While advisory systems have little notable contribution to make, a voluntary overridable system providing haptic feedback shows significant potential to improve road safety, as outlined below. Safety experts believe that this system should be mandatorily required on a path to full automation which would include vehicle speed which is physically limited by the ISA system. It is expected that the voluntary overridable system will be required mandatorily in the forthcoming revision of the General Safety Regulation.

Table 10: Intelligent speed assistance systems and safety effects

Speed assist systems	Advisory – a warning signal which alerts the driver to when their speed is too great	5% reduction in fatal crashes and 4% reduction in serious crashes.[107]
	Voluntary – the driver chooses whether the system restricts their vehicle speed and/or the speed it is restricted to.	21% reduction in fatal crashes and 14% reduction in serious crashes.
	Mandatory - the driver's speed selection is physically limited by the ISA system	46% reduction in fatal crashes and 34% reduction in serious crashes.
		Annual reduction of 37% of fatal crashes cited in TRL report for speed assist in general.[108]

Speed limit enforcement and publicity

The enforcement of speed limits is increasingly automated by use of mobile and fixed speed cameras at roadsides at high-risk sites and sections to large effect. Average speed camera implementation is being used increasingly and has led to a 25%-46% reduction in fatal and serious collisions where used in Britain.[109] Speed enforcement is most effective when accompanied by publicity and information with the aim of achieving a deterrent effect.

Recommendations for EU action:

- Adopt KPIs for improving the level of safe speeds on different road types in the EU
- Agree protocols with Member States on safe speed measurement
- Work with Member States to monitor and target progress on these to 2030.
- Prepare guidance on safe speeds and limits
- Mandate within the revision of the General Safety Regulation voluntary overridable;
- ISA in the first instance, progressing to the non-overridable system on the path to
- full automation.
- Promote and fund speed limit enforcement on the TEN-T and other roads.
- Support Safe Cities demonstration projects with a safe speed element.

[107] Carsten O (2012). Personal communication of additional results to study Lai F, Carsten O and Tate F. How much benefit does Intelligent Speed Adaptation deliver: An analysis of its potential contribution to safety and environment, Accident Analysis and Prevention 48 (2012) 63– 72.

[108] Hynd D, McCarthy M, Carroll JA, Seidl S, Edwards M, Visvikis C, Reed R and A Stevens (2014), Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users: Final Report, TRL, Crowthorne.

[109] Owen R, Ursachi G and R E Allsop (2016) The Effectiveness of Average Speed Cameras in Great Britain, RAC Foundation, London.

Recommendations for national action

- Adopt, measure, target and monitor progress on KPIs for improving the level of safe speeds by road type.
- Review and review speed limits where necessary within national road classifications in line with a Safe System approach.
- Fund a national programme of fixed, mobile and average speed camera enforcement accompanied by supporting awareness campaigns on the adverse consequences of unsafe speeds.
- Nationally fast-track the fitment of voluntary overridable ISA.

Increasing the safety quality of new vehicles

Introduction

Vehicle safety is an important Safe System strategy. The aim is to support correct in-vehicle use and to protect drivers and passengers as well as road users outside the vehicle such that if crashes occur, they do not lead to death and serious injury. Vehicle safety addresses the safety of all road users and comprises measures to help avoid a crash (crash avoidance), mitigate the severity of a crash before it occurs by slowing the vehicle using intelligent speed management or advanced braking (crash mitigation) reduce injury in the event of a crash (crash protection) and reduce the consequences of injury (post-crash response). Increasingly, vehicle systems which can integrate vehicle and road network interventions (integrated systems) are being pursued. [110]

It is widely acknowledged that improved vehicle safety performance is brought about by the combination of regulation and harmonised standards; consumer information; public procurement policies to fast-track fitment of proven safety technologies; and industry initiatives.

Relationship with the prevention and mitigation of death and serious injury

Over the past 20 years, substantial and evidence-based improvements have been made in vehicle safety. Improvements in vehicle safety design over this period brought about by a combination of activity have reduced the risk of death and serious injury for car occupants by 50% or more.[111]

Euro NCAP has made a significant contribution towards this reduction and provides valuable assessment and promotion of demonstrably effective new safety technologies. Research shows that 5-star rated Euro NCAP cars have a 68% lower risk of fatal injury and a 23% lower risk of serious injury compared to 2-star rated cars.[112] An annual assessment of the safety quality of the EU vehicle fleet using Euro NCAP ratings is not available.

Key safety performance indicator

The main means of improving the safety of vehicles is addressing the new vehicle fleet which can be addressed by the following indicator:

[110] European Commission (2016) Vehicle Safety, European Commission, Directorate General for Transport, Brussels.

[111] SARAC II study (2006). (https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/pdf/projects/saracii.pdf

[112] Kullgren A, Lie A, Tingvall C (2010). Comparison between Euro NCAP test results and real-world crash data. Traffic Injury Prevention. 2010 Dec 11(6):587-93.

- Proportion of new passenger cars with a 5-star Euro NCAP rating.

It should be noted that the allocation of stars will evolve over time according to adaptation to technical progress and this is not taken into account in the potential safety effect estimate to 2030 which is based on Euro NCAP (2013). It is also noted that the relationship between vehicle design and vehicle safety is complex, as vehicle mass and vehicle ageing (both the deterioration of ageing cars and the technical improvements of new cars) play a role.

Assumptions
100% take up of Euro NCAP 5-star rating in the new vehicle fleet

Safety effect
It is estimated that around at least 3295 lives might be saved with 100% take up of Euro NCAP 5-star rates in the new vehicle fleet based on the current rating.

Alignment with other societal objectives
This indicator aligns particularly well and shares co-benefits with:

- economic objectives for high quality vehicles
- public health objectives to reduce death and serious injury;
- environmental objectives to minimise high speeds to reduce emissions;
- occupational health and safety objectives for fleet safety;
- tourism objectives for the rental and leasing of vehicles

Key intervention priorities and institutional delivery
Research has identified substantial scope for further enhancement.[113] There is significant potential to improve crash protection further.

For car occupants, frontal and side impact crashes remain the priorities for further developments in crash protection in car-to-car, car-to-truck and car- to-rigid object crashes. These will require a combination of measures which directly address these crash scenarios and compatibility needs. There is large potential for further reductions in pedestrian and cyclist deaths and serious injuries as manufacturers make further progress in addressing state of the art crash tests. Key activity will include adapting existing type approval standards to technical progress in line with Euro NCAP recommendations and protocols. There is large future promise of casualty reduction for all road users from crash avoidance and active safety technologies as long as development is prioritised to maximise casualty reduction. Priority needs here are in-vehicle measures to assist driver compliance with key safety rules – speed, alcohol and occupant restraint use and advances in braking and conspicuity systems. The potential value of developing an integrated approach to vehicle safety, linking preventive, crash protection and post-crash approaches into cooperative systems for drivers, passengers and vulnerable road users as well as vehicle and road network safety systems is being increasingly understood. [114]

Revision of the General Safety Regulation and Pedestrian Safety Regulation
The setting of legal requirements to provide harmonised, minimum vehicle safety standards albeit offering a high level of protection is an essential and highly effective activity. EU Whole Vehicle Type Approval provides the framework beyond which

[113] European Commission (2017) Seidl M, Hynd D, McCarthy M, Martin P, Hunt R, Mohan S, Krishnamurthy V and S O'Connell. In depth cost-effectiveness analysis of the identified measures and features regarding the way forward for EU vehicle safety. Final Report, Brussels.
[114] European Commission (2016) Vehicle Safety, European Commission, Directorate General for Transport, Brussels.

programmes such as Euro NCAP can encourage the industry towards providing the highest levels of protection.

Following an impact assessment, the Commission is expected to bring forward in 2018 proposals to amend the General Safety Regulation 661/2009 and the Pedestrian Protection Regulation 78/2009, which regulate vehicle safety and in-vehicle technology in the EU.[115]

Active consideration is being given to a large package of measures comprising measures for Driver Assistance (permanent/ongoing collision mitigation); Active Safety (mitigation immediately pre-collision) and Passive Safety (protection during collision). These include the introduction of active systems such as automatic emergency braking systems for pedestrians and cyclists, intelligent, overridable speed assistance, lane keeping assistance, enhancement of passive safety features such as advanced seat belt reminders, as well as improved pedestrian cushioning in case of head impacts onto the front of cars and bicyclist detection in case of imminent collision, pole side impact protection and improvements in frontal crash protection. Other areas include the improvement of direct vision and elimination of blind spots on trucks to protect vulnerable road users and event data recorders.[116]

Research indicates that the casualty reduction potential of available measures is substantial preventing many thousands of deaths and serious injuries in motor vehicle collisions. [117] [118] Examples of research-based measures which safety experts believe are particularly important for improving road safety are presented in Table 10.

[115] European Commission (2016). Report from the Commission to the European Parliament and the Council. Saving Lives: Boosting Car Safety in the EU. Reporting on the monitoring and assessment of advanced vehicle safety features, their cost effectiveness and feasibility for the review of the regulations on general vehicle safety and on the protection of pedestrians and other vulnerable road users, December 2016, Brussels.

[116] Commission staff working document (2016) Accompanying the document Report from the Commission to the European Parliament and the Council Saving Lives: Boosting Car Safety in the EU Reporting on the monitoring and assessment of advanced vehicle safety features, their cost effectiveness and feasibility for the review of the regulations on general vehicle safety and on the protection of pedestrians and other vulnerable road users {COM (2016) 787 final}

[117] Hynd, D., McCarthy, M., Carroll, J., Seidl, M., Edwards, M., Visvikis, C., Tress, M., Reed, N. and Stevens, A. (2015). Benefit and feasibility of a range of new technologies and unregulated measures in the fields for occupant safety and protection of vulnerable road users. Final Report. Brussels: European Commission. http://bookshop.europa.eu/en/benefit-and-feasibility-of-a-range-of-new-technologies-and-unregulated-

[118]) Seidl M, Hynd D, McCarthy M, Martin P, Hunt R, Mohan S, Krishnamurthy V and S O'Connell (2017) In depth cost-effectiveness analysis of the identified measures and features regarding the way forward for EU vehicle safety. Final Report, Brussels.

Table 10: Key vehicle safety measures

Intelligent speed assistance (overridable) (M1, M2 M3, N1, N2, N3) [119]
Autonomous Emergency Braking for Pedestrians and Cyclists (M1, M2 M3, N1, N2, N3)
Drowsiness and Distraction Recognition (M1, M2 M3, N1, N2, N3)
Improved car and light van crashworthiness for pedestrians (adult head form to windscreen area testing) (M1, N1)
Vehicle front design improvements – direct vision and VRU detection (M3 and N3)
Autonomous Emergency Braking for car and light vans (M1, N1)
Lane keeping assist for cars and light vans (M1, N1)
Event data recorders for cars and light vans (M1, N1)
Alcohol interlocks (M1, M2, M3, N1, N2, N3)
Side impact collision protection for far-side occupants (M1, N1)
Pole side impact crash test for cars and light vans (M1, N1)
Full-width Frontal Occupant Protection (M1, N1)
Small overlap Frontal Occupant Protection (M1)
Rear underrun protection (N2, N3)
Front underrun protection (N2, N3)
Advanced seat belt reminders (M1, M2, M3, N1, N2, N3)
Reversing camera or detection system (M1, M2, M3, N1, N2, N3)
Direct vision and VRU detection (M2, M3, N2, N3)

The Commission's forthcoming impact assessment is expected to set out the benefits and costs of a large package of measures and which take into account their interaction following further evaluation. A substantial saving in death and serious injuries is expected to be identified from a range of advanced driver assistance and crash protection technologies.

Promotion of highest level of Euro NCAP * rating performance and vehicle safety technologies

Systematic rating of the safety quality of vehicles key crash tests is carried out by the European New Car Assessment Programme (Euro NCAP). The Euro NCAP star rating tool provides a demonstrably effective tool which can be used measure and target progress in improving the safety quality of new vehicles. According to ETSC research,

[119] Category N1: Vehicles designed and constructed for the carriage of goods and having a maximum mass not exceeding 3,5 tonnes.
Category N2: Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 3,5 tonnes but not exceeding 12 tonnes.
Category N3: Vehicles designed and constructed for the carriage of goods and having a maximum mass exceeding 12 tonnes.
Category M1: Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.
Category M2: Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes.
Category M3: Vehicles designed and constructed for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass exceeding 5 tonnes.

many vehicles are tested by the Euro NCAP consumer testing programme, cars that only meet the minimum EU legal requirements today would receive zero stars.

In 2017, approximately 94% of cars sold on the European market were covered by a Euro NCAP rating. Of the cars that have a valid rating, about 76% are 5-star, 17% 4-star and 7% are ≤3-star.

Promotion and fast-tracking of new technologies is needed to ensure faster take-up. A number of additional, useful delivery mechanisms at EU and national levels for the implementation of vehicle safety technologies have been identified by the Commission.[120] These and further options are highlighted below:

Reducing the average age of the vehicle fleet?

The average age of the EU vehicle fleet is increasing. Currently, this is 10.7 years compared with 8.5 in 2010. The oldest national fleet is almost twice as old as the age of the youngest.[121] The younger the fleet, the greater the opportunity for countries to benefit from life-saving technologies being introduced into new vehicles with the highest Euro NCAP rating. At the same time, while many view this as a potential KPI, this is not recommended by this study. A KPI to reduce the average age of the fleet is highly dependent on Euro NCAP safety rating. A new 2-star or 3-star vehicle will be less safe than an older 4-star or 5-star vehicle.

Public procurement policies

Public procurement can provide important leverage by requiring that vehicles used within contracts with a public administration confirm to the highest Euro NCAP star rating or be equipped with minimum safety features. The Europe 2020 strategy for smart, sustainable and inclusive growth' (2010) includes public procurement as one of the market-based instruments to be used to achieve smart, sustainable and inclusive growth while ensuring the most efficient use of public funds. New EU Directives on public procurement (Directive 2014/24/EU) came into force on 17 April 2014. However, while environmental protection and social issues are included in the scope, the opportunity to include road and vehicle safety is omitted and needs to be addressed.

Tax incentives

Member States' authorities can provide tax incentives to promote the fitting of additional safety systems and require Euro NCAP 5-star vehicles in the same way they are provided for e.g. environmentally friendly technologies. As ACEA has noted, measures to drive fleet renewal might be encouraged since the average age of cars in some countries can be up to 17 years. As discussed above, it will also be necessary in these circumstances to ensure that such measures also relate to the highest Euro NCAP ratings to ensure maximum safety value.

Insurance premiums

Insurance companies often take into account the safety systems fitted to a vehicle when determining the amount of insurance premium offered. For example, some insurance companies offer discounts to drivers who accept the fitting of an Event Data Recorder. Similar incentives could be especially relevant for key crash avoidance technologies such as ISA and alcolocks.

[120] Commission Staff Working Document on the implementation of objectives 4 and 5 of the European Commission's policy orientations on road safety 2011-2020 – deployment of vehicle technologies to improve road safety, Brussels, 3.10.2014 SWD (2014) 297 final.
[121] ACEA (2017). Pocket Guide, Brussels.

Stars on Cars promotion

The Stars on Cars programme model used in Australia provides a useful promotional mechanism. It provides new car dealerships with point-of-sale material identifying vehicles which hold the maximum 5-star ANCAP safety rating. Programmes are being run across metropolitan and regional new car dealerships in Western Australia and South Australia. The South Australia programme ran from 2011 to 2013 which increased take up from below to above the national rate of 5* new vehicle purchases.[122]

Safe travel policies

A further means of promoting and encouraging new safety technologies and the highest standards of cars is within Government and organisation safe travel policies. The Commission, through the EU Health and Safety at Work agency, could devise safe travel policies for the European Commission as well as promoting take up of ISO 39001 on road safety management systems for organisations. The tourism sector could be encouraged to promote the highest star-rated Euro NCAP cars in holiday car hire.

Safety management of automation and the path to driverless vehicles

While the eventual benefits of driverless vehicles hold great potential for addressing safety outcomes, the development is likely to run through the next two decades. The path to full, efficient and safety automation is with complexities and new safety hazards. Safety and insurance industry experts raise a range of questions. These concern the dangerous mix of different levels of automation technologies, whether current and planned developments fall within the Safe System approach, the urgent need for the development of common standards, and how regulators will ensure autonomous systems are tested and approved to common standards, especially in a world where cars are already receiving over-the-air software updates that affect safety performance, such as Tesla's autopilot updates. The need for research and development towards a new, harmonised regulatory framework of standard and protocols for automated driving at EU level is urgent. The EU type approval regime will need to be revised to ensure that automated vehicles comply with all the specific obligations and safety considerations of traffic law in different member states as well as state of the art crash protection. ETSC has suggested that this should cover all the new safety functions of automated vehicles, to the extent that an automated vehicle will pass a comprehensive test equivalent to a 'driving test'. This would take into account high-risk scenarios for occupants and interactions with cyclists, pedestrians and powered two wheelers.

Cooperative, connected and automated vehicles

Cooperative intelligent transport systems (C-ITS) that provide communication between the vehicle and other vehicles as well as the infrastructure are designed to assist the driver in taking the right decision and adapt to the traffic situation. They have the potential to significantly improve road safety if those with the greatest safety potential are prioritised and implemented. [123] The European Transport Safety Council highlights, in-vehicle dynamic speed limits, emergency electronic braking lights, road works warnings, weather conditions, intersection safety and vulnerable road user protection as priorities.

[122] Leyson M and F Doyle (2012) ANCAP Stars on Cars Dealership Program- Increase Sales of 4 and 5 Star Rated Cars, Australasian Road Safety Research, Policing and Education Conference 2012 4 - 6 October 2012, Wellington, New Zealand.

[123] C-ITS Platform Phase II (September 2017) Cooperative Intelligent Transport Systems towards Cooperative, Connected and Automated Mobility. Final Report. https://goo.gl/XMbwF8.

Recommendations for EU action:

- Adopt a KPI on the proportion of new passenger cars with a 5-star Euro NCAP rating.
- Work with Member States and Euro NCAP to monitor and target progress on this to 2030.
- Adopt the proposed package proposed by the Commission for the revision of the General Safety Regulation and Pedestrian Safety Regulation with special priority and urgency being given to:
  - voluntary overridable intelligent speed adaptation in motor vehicles
  - automated emergency braking for pedestrians and cyclists
  - improvements to frontal and side impact crash protection tests
  - improvements to pedestrian crash protection tests
  - HGV standards to improve driver vision and vulnerable road user protection
  - measures to reduce driver distraction and impairment
  - lane keeping assist
  - event data recorders
- Amend the EC Directive 2014/24/EU on public procurement to include vehicle safety measures and promote Euro NCAP 5-star vehicles in Commission public procurement of transport services.
- Encourage occupational and tourism sectors to promote take up of Euro NCAP 5-star rated vehicles in health and safety and car rental and leasing activity.
- Invite the High-Level Group on Road Safety to consider national incentives to fast-track proven technologies by a range of means including procurement, safe travel policies, tax and insurance incentives.
- Address the safety needs (design, allowable speeds, use of safety equipment) associated with the use of electric bicycles at speeds higher than 10 km/h.
- Establish a new, harmonised regulatory framework and EU Code of Practice to determine a safe framework for automated driving at EU level.
- Establish a timetable for the introduction of safety-enhancing C-ITS services and what can be achieved to 2030.
- Ensure that Safe Vehicle research is funded in EU research programmes.

Recommendations for national action

- Adopt, measure, target and monitor progress on the KPI on the proportion of new passenger cars in the national fleet with a 5-star Euro NCAP rating.
- Fast-track improvements in vehicle safety and take up of Euro NCAP 5-star rated vehicles
- wherever possible in advance of legislative lead times through in house safe travel policies, public procurement policies and tax and insurance incentives.
- Encourage occupational and tourism sectors to promote take up of Euro NCAP 5-star rated vehicles in health and safety and car rental and leasing activity.

Increasing the efficiency and effectiveness of post-crash care

Introduction

Road traffic injury is a leading cause of major trauma comprising around one third of all severe injury. Both at national and international levels, post-crash care has had the least attention as a specific intervention in road safety strategy. Post-crash care, a key Safe System strategy concerns the rescue, treatment and rehabilitation of crash victims. The aim is for efficient emergency notification, fast transport of qualified

medical personnel, correct diagnosis at the scene, stabilisation of the patient, prompt transport to point of treatment, quality emergency room and trauma care, and extensive rehabilitation services. The aim is to reduce the severity if injury and its consequences should a crash injury occur. The provision of different aspects of post-crash care differs widely across EU countries. [124]

Relationship with the prevention and mitigation of death and serious injury

The appropriate management of road casualties following a crash is a crucial determinant of the chance and quality of survival. Research indicates that about 50% of deaths from road traffic collisions occur within minutes at the scene or in transit and before arrival at hospital. For those patients who are taken to hospital, some deaths occur within the first 4 hours after the crash (15%) but the majority occur after 4 hours (35%). Clinicians acknowledge that there is not so much a "golden hour" in which interventions have to take place as a chain of opportunities for intervening across a longer timescale. [125] Research indicates that reducing the time between crash occurrence and the arrival of EM services from 25 to 15 minutes could reduce deaths by one third. [126] The SafetyNet project estimated that according to specific estimates attained in different countries, 10%-13% of crash fatalities might be prevented due to improved post-crash care.[127]

Key safety performance indicator

This Safe System field provides most difficult in the setting of appropriate indicators, given the lack of measurable information for key elements. Experts agree that improving initial access to professional emergency medical help from notification is a prerequisite of post-crash care. The proposed indicator is:

- Proportion of seriously injured road crash victims with access to professional medical assistance within15 minutes of notification.

Assumptions

- Many based on uncertain data – a possible 10% fatality reducing effect with a perfect EMS system.

Safety effect

- A target of 100% access within 15 minutes to professional medical assistance within an effective and efficient emergency medical system, it is very roughly estimated that around 2600 road deaths might be prevented.

Alignment with other societal objectives

This indicator aligns particularly well and shares co-benefits with:

- public health objectives to reduce death and serious injury;
- occupational health and safety objectives for fleet safety;
- economic development objectives for vehicle quality.

Key intervention priorities

Efficient emergency notification, fast transport of qualified medical personnel, correct diagnosis at the scene, stabilisation of the patient and prompt transport to point of

[124] European Commission (2016) ERSO Traffic safety synthesis on post-impact care, Brussels.

[125] European Commission, Post-impact Care, ERSO Synthesis, European Commission, Directorate General for Transport, September 2016.

[126] Rocío Sánchez-Mangas, Antonio García-Ferrer, Aranzazu de Juan, Antonio Martín Arroyo. "The probability of death in road traffic accidents. How important is a quick medical response?" Accident Analysis and Prevention 42 (2010) 1048.

[127] EU SafetyNet project (2005) Deliverable D3.1: State of the art Report on Road Safety Performance Indicators, Brussels.

treatment are the objectives of this field of intervention. The quicker the patient has access to professional emergency medical assistance, the greater the chances of surviving and making a full recovery.

At EU level, the e-Call system provides a significant opportunity to reduce the time between crash occurrence and emergency notification. Directive 2010/40/EC provides for the mandatory fitment of e-Call which is a system for sending automated emergency calls to the emergency service from vehicles in the event of a crash. It comes into effect for new models in 2018.

It is estimated that with e-Call, emergency services' response time could be reduced by 50% in rural areas and 40% in urban areas, leading to a reduction of fatalities estimated at between 2% and 10%, and reduction of severity of injuries between 2% and 15% depending on the country considered. The benefit-to cost ratio has been estimated at 1.74.[128]

As regards possible first aid measure applied by lay bystanders, according to the World Health Organization, there is no strong evidence that basic first aid training by drivers and members of the public would decrease pre-hospital mortality. There is, however, some evidence internationally, about the value of first responder training for commercial drivers and emergency services staff.[129]

Post-crash care falls mainly within the competence of Member States. However, the Commission can play a key role in addition to its e-Call activity (see below) in funding studies, encouraging the establishment of trauma registries and other monitoring and evaluation as well as promoting best practice.

Recommendations for EU action:

- Set an EU KPI on the proportion of seriously injured road crash victims with access to professional medical assistance within15 minutes of notification to improve the efficiency and effectiveness of post-crash care.
- Work with Member States to monitor and target progress against it to 2030.
- Commission a study to review the scope of post impact care in reducing the consequences of serious injury in road collisions;
- Monitor and rank annually through EU databases the role of road traffic injury as cause of death and disability compared with other mortality and morbidity.
- Include first responder training in EU provisions for commercial and public transport driver training and emergency services personnel

Recommendations for national action

- Measure, target and monitor progress on KPIs for improving the efficiency and effectiveness of post-crash care including the proposed EU KPI.
- Review the contribution of improvements to post crash care to reducing deaths and serious injuries at national level.
- Carry out first responder training for commercial and public transport driver training and emergency services personnel

[128] European Commission Staff Working Document Impact Assessment Accompanying the document Commission Recommendation on support for an EU-wide e-Call service in electronic communication networks for the transmission of in-vehicle emergency calls based on 112 (e-Calls), C 2011,6269 final}

[129] Eds. Peden M, Scurfield R, Sleet D, Mohan D, Hyder A, Jarawan E and C Mathers (2004). World Report on Road Traffic Injury Prevention, World Health Organisation, World Bank, Geneva.

Increasing levels of safe road use

Overview

In addition to the assistance provided to users through other Safe System strategies. the standards and compliance regimes for the licensing and disqualification of driver and riders and for key safety behaviours (seat belt use, child restraint use, crash helmet use, driving without alcohol and other drugs; driving without distraction) are important for the prevention and mitigation of fatal and serious injury risk in road collisions. The aim is for road users to have the knowledge, capability, capacity and willingness to use roads and vehicles safely such that if crashes occur, they do not lead to death and serious injury.

The main frameworks for EU action in this sphere of activity comprise the Cross-Border Enforcement Directive, the Driving Licence framework and EU Whole Vehicle Type Approval. The main in-vehicle driver assistance aspects are covered in the section on vehicles.

Cross- border enforcement of key safety rules

The Cross-Border Directive 2015/413 covers rules on speed, use of alcohol and other drugs while driving, use of seat belts and mobile phone use while driving. An increase in combined publicity and enforcement of key road safety rules – speed in particular - is the main mechanism by which improved road safety results can be achieved in the short term. A European Transport Safety Council study has identified barriers to progress and specific priority areas for improving the effectiveness of implementation which include specific funding for the enforcement of excess speed and excess alcohol rules; better information on penalties including the payment of fines; mutual recognition of driver disqualification and penalty points and the need for further knowledge transfer on best practice activity.[130]

Recommendations for EU action:

- Review the implementation of the Cross-Border Directive 2015/413 and consider mutual recognition of driver disqualification and further exchange of information on enforcement of key road safety rules.
- Fund high-visibility cross-border enforcement operations organised by the European Traffic Police Network (TISPOL).
- Carry out research on drivers' and riders' perceptions of the risk of being detected for key road safety offences.

Graduated driver licensing

The first two years of driving present major risks to young novice drivers and the driver licensing and testing regime can play an important role. For example, if novice drivers increased their on-road supervised practice from 50 to 120 hours or more, crash risk might be reduced by 30% in the first year of driving.[131] Graduated access to a full licence subject to various requirements (e.g. accompanied driving, speed, alcohol and passenger number restrictions) can play a key role in managing exposure to risk.[132] Hazard perception testing is also identified as a promising means to improve road safety.

[130] ETSC (2016). PIN Flash: Enforcement can contribute to safer roads, Brussels.

[131] VicRoads (2003) Enhancing the Safety of Young Drivers A Resource for Local Communities, Melbourne.

[132] Kinnear, N., Lloyd, L., Helman, S., Husband, P., Scoons, J., Jones, S., Stradling, S., McKenna, F. and Broughton J. (2013). Novice drivers: evidence review and evaluation – pre-driver education and training, graduated driver licensing, and the New Drivers Act. Published Project Report (PPR673). TRL,

Key safety performance indicator:
None selected.

Alignment with other societal objectives
This activity aligns particularly well and shares co-benefits with public health objectives to reduce death and serious injury;

Key intervention priorities and aspects of institutional delivery
The introduction of graduated driver licensing (GDL) schemes for car drivers helps to manage exposure to high risk in the initial years of driving. It comprises a number of components at learner and intermediate stages which create a framework for initial driving experience before gaining a provisional and full licence under lower-risk conditions. Countries have implemented different packages of GDL measures. A recent review found that key components in the learner stage are the minimum learning period (the duration of a provisional licence), minimum required amounts of accompanied driving, minimum age for graduation to intermediate stage (the higher the licensing age the lower the crash risk). The most effective components of the intermediate stage (and for GDL in general) are restrictions on solo night driving and restrictions on carriage of passengers under 30 years old for novices under 30 years old. In addition, a lower alcohol limit and a ban on hands free mobile phone use (where these do not exist for all drivers) are likely to reduce collisions and their severity. Research indicates that GDL has been effective in reducing collisions wherever implemented and that reductions are seen for novice drivers of all ages.[132] [133]

The Commission could consider, as a minimum, proposing a recommendation on good practice in graduated driver licencing.

Recommendation for EU action:

- Provide a recommendation on good practice in graduated driver licencing to encourage take up of demonstrably effective practice by Member States.

Recommendation for national action

- Implement graduated driver licensing systems in accordance with good practice to assist young novice drivers manage their exposure to risk in the first years of driving.

Increasing seat belt and child restraint use

Introduction
Despite the legal obligation to wear a seat belt across the EU28, seat belt use in cars in the EU is estimated to be only 90% for front seat and 71% for rear seat passengers in countries that are monitoring wearing rates.[134] Road traffic injuries are the leading cause of death and severe injuries among children aged 0–14 years.[135] Half of child deaths are to car occupants.[136] Information on child restraint usage rates is not

Crowthorne.
[133] Healy D, Catchpole C, Harrison W (2012). Victoria's Graduated Licensing System Evaluation Interim Report, VICROADS, Melbourne.
[134] ETSC (2016) PIN Flash Report 31, How Traffic Law Enforcement Can Contribute to Safer Roads, Brussels.
[135] http://www.childsafetyeurope.org/injurytopics/roadsafety/index.html
[136] PIN Flash 34: Reducing Child Deaths on European Roads, Brussels.

widely available. According to ESRA results, 62% of all child car occupants (up to 150 cm) use some sort of child restraint.

Increasing the use of seat belts and child restraint systems in motor vehicles continues to be a highly important and a critical Safe System strategy. The design and effectiveness of a range of interventions such as vehicle and road infrastructure safety rely upon seat belt use protection. While much has been achieved over decades, wearing levels are insufficiently high in most Member States. While many countries have achieved front seat belt wearing levels of over 90%, in-depth crash injury investigations indicate that wearing is less high in serious and fatal car crashes. Research in Sweden concluded that 27% of the occupants in crashes with MAIS2+ injury and 40% of the fatally injured car occupants were not wearing seat belts in road crashes.[137] The lowest levels of front seat belt use are in Romania and Croatia which are below 70%. Recent observational studies indicate that wearing levels in the rear seats is much lower ranging from 99% in Germany to only 11% in Italy.[138]

Across the EU, an estimated 8,600 occupants of cars survived life-threatening collisions in 2012 because they wore a seat belt. ETSC estimates that another 900 deaths could have been prevented if 99% of all occupants had been wearing a seat belt.[139]

Relationship with the prevention and mitigation of death and serious injury

The use of seat belts and child restraints reduces deaths and serious injuries by between 45% – 60%. A meta-analysis of 29 studies of seat belt use found that seat belts reduced the risk of death and serious injury amongst front seat occupants of cars and vans by at least 45%.[140] The use of child restraints leads to at least a 60% reduction in deaths. [141] Correct fitment and use is an ongoing issue that needs to be addressed. [136]

Key safety performance indicators

- Proportion of motor vehicle occupants using a seat belt in a) front seats and b) rear seats
- Proportion of correct use of child restraints by child occupants

It is recommended that observational studies rather than self-reporting methodologies are used for this indicator. While the use of the former is sometimes seen as being too difficult in operational terms, observational studies continue to be carried out successfully in several Member States.

Assumptions

- 100% use of seat belts in all seating positions and 100% use of child restraints.
- 62% of all child car occupants (up to 150 cm) use some sort of child restraint.
- As a very rough estimate it is assumed that the wearing rate is approximately 83%.

Safety effects of KPIs

- It is estimated that around 905 lives might be saved if all occupants wore seat belts.

[137] Stigson H, Kullgren A and Krafft M (2011). Use of Car Crashes Resulting in Injuries to Identify System Weaknesses, 22nd International Technical Conference on the Enhanced Safety of Vehicles (ESV). Washington DC. DOT/NHTSA.
[138] ITF (2017) Road Safety Annual Report 2017, OECD publishing, Paris.
[139] ETSC (2014). Ranking Progress on EU Car Occupant Safety PIN Flash Report 27, Brussels.
[140] Elvik et al (2009). Road Safety Handbook, TOI, Oslo.
[141] Hakkert et al (2008), SafetyNet Project, Brussels.

- It is estimated that around 31 lives can be saved annually in EU28 by increasing child restraint use in cars to 100%.

Alignment with other societal objectives

This indicator aligns particularly well and shares co-benefits with:

- public health objectives to prevent and reduce deaths and serious injuries;
- sustainable transport goals;
- occupational health and safety objectives for fleet safety;
- economic development objectives (safety equipment sector).

Key intervention priorities and aspects of institutional delivery

Seat belt reminders

Seat belt reminders continue to be the key intervention to address insufficient seat belt use. Measurements in eleven large European cities indicated that seat belt reminders increased the seat belt use rate from 85.8% to 97.5%.[142] Advanced seat belt reminders, already available in front seats, need to be available for all seating positions. Seat belt reminders on rear seats (and front seats in buses and trucks) is included in Regulation 16 that has been adopted at United Nations level and will be mandatory for new vehicle types (as regards safety belts system approval) from 1/9/2019, for all new vehicles 1/9/2021.

Seat belt enforcement and awareness campaigns

Better compliance through combined social marketing and police enforcement will be needed particularly in countries with lower than average levels of front seat belt use and to increase rear seat belt wearing levels which are usually lower than in the front seat.

Reduced VAT rates on child restraints

EU Directive 77/388/EEC includes child restraint systems in the category 'essential product' on which VAT can be charged at a lower rate of 5%. However, only a few EU Member States have taken advantage of the possibility to reduce the VAT for child restraints and make them more affordable for all parents.[143]

Recommendations for EU action:

- Set EU KPIs to increase the use of seat belts and child restraints:
  -Proportion of motor vehicle occupants using a seat belt in a) front seats and b) rear seats
  -Proportion of correct use of child restraints by child occupants
- Work with Member States to monitor and target progress against these to 2030.
- Increase availability and affordability of child restraints, by including them in the category of essential products in EU Directive 77/388/EEC.
- Encourage Member States to introduce lower VAT for child restraints.
- Encourage taxi companies to provide their fleet with child safety restraints.

Recommendations for national action

- Adopt, measure, target, monitor and report progress on KPIs on proportion of the use of seat belts in a) front seats and b) rear seats and the proportion of correct use of child restraints by child occupants.

[142] Lie et al. (2008) Intelligent seat belt reminders-do they change driver seat belt use in Europe? Traffic Injury Prevention.2008 Oct;9(5):446-9.
[143] PIN Flash 34: Reducing Child Deaths on European Roads, Brussels.

- Fund combined publicity and enforcement campaigns to encourage compliance with seat belt and child restraint rules.
- Introduce zero-rated Value Added Tax for child restraints.
- Encourage taxi companies to provide their fleet with child safety restraints.

Increasing crash helmet use

Introduction

Head injury is the leading cause of death and major trauma for motorcyclists, moped users and pedal cyclists in road collisions. Riders and passengers on mopeds and motorcycles have a higher risk of injury than any other group of road users. Head injuries cause 75% all motorcyclist deaths and around 25% of serious injuries.

Although use is not covered by EU Directive, all Member States have motorcycle crash helmet wearing laws. However, there are some exceptions in some wearing laws which exclude small mopeds (mofas with engines >50cm3). However, data on current levels of helmet use by riders is incomplete for EU 28. Many countries report high levels of use, but there are indications of potential for improvement in some countries e.g. Italy, Greece, Croatia and Romania.

Few EU countries mandate the use of bicycle helmets by children and young people varying between 12 and 18 years. Cycling wearing rates are mostly below 50% but can be as low as 12%.[144]

Relationship with the prevention and mitigation of death and serious injury

Research indicates that motorcycle helmet use reduces the number of fatal injuries by around 44% and serious head injuries by 49%.[145] Incorrect fastening of helmets is common and negates potential crash helmet protection. There is also considerable variation in the safety quality of different helmets. Around 20% of fatal and serious head injuries could be reduced by a recommended and achievable improvement in crash helmet performance.[146]

Helmets for cyclists can reduce serious and fatal head injury by around two thirds. (65% reduction in in death and a 69% reduction on serious head injury).[147] Two out three permanent head injuries could be avoided through their use.[148] In a Swedish study, 71% did not use a helmet and of these 43% would have survived with it. [149] Unfortunately, much less is known of the proportion of cyclists dying from head injuries as opposed to other fatal injuries in other body regions. Other research studies indicate that the overall contribution of helmet use to fatality reduction may be less.[150] [151] There is no evidence that any reductions in cycling due to mandatory

[144] Monitoring road safety in the EU: towards a comprehensive set of Safety Performance Indicators
[145] Elvik R, Vaa T, Hoye A, Erke A and M Sorensen Eds. (2009). The Handbook of Road Safety Measures, 2nd revised edition Emerald Group Publishing Limited, ISBN: 9781848552500.
[146] COST 327 (2001). Motorcycle Helmets, Final Report, Brussels.
[147] Olivier J and P Creighton, 2016: Bicycle helmets ad helmet use: a systematic review and metanalysis: In International Journal of Epidemiology.
[148] Rizzi, M, Stigson H, Krafft M. 2013). Cyclist injuries leading to permanent medical impairment in Sweden and the effect of bicycle helmets. Int. IRCOBI Conf. on the Biomechanics of Injury, 2013 Gothenburg, Sweden.
[149] Kullgren, A., M. Rizzi, H. Stigson, A. Ydenius and J. Strandroth. 2017. The potential of vehicle and road infrastructure interventions in fatal pedestrian and bicyclist accidents on Swedish rural roads –what can in-depth studies tell us? 25th ESV Conference, 2017 Detroit. Paper number 17-0284
[150] Bíl et al. (SafetyScience 2018, 71-76)
[151] Persaud et al. (CMAJ 2012. DOI:10.1503/cmaj .120988

helmet use are maintained over a prolonged period, though a mandatory requirement is not envisaged for take-up in this study.

Key safety performance indicator

- Proportions of a) motorcyclists, b) moped users and c) pedal cyclists with correct use of a protective helmet.

It is recommended that observational studies of actual helmet use in normal traffic are used for this indicator rather than self-reporting methodologies.

Assumptions

- *100% correct use of helmets by a) motorcyclists, b) moped users and c) pedal cyclists*
- Use of helmets by riders of all types of powered two wheelers.
- A conservative 40% fatality reducing effect of helmets by PTW riders.
- A 36% fatality reducing effect of helmets by cyclists.

Safety effects

- It is roughly estimated that that 100% helmet use by P2W-riders would save 206 road deaths.
- The safety effect of the cycle helmet indicator is estimated to be approximately 740 road deaths saved annually, assuming a currently low proportion of helmet use, and assuming that bicycle use will neither decrease due to an adverse effect of helmet wearing measures, nor increase due to increased popularity of cycling.

Alignment with other societal objectives

This indicator aligns particularly well and shares co-benefits with:

- public health objectives to reduce death and serious injury;
- occupational health and safety objectives for motorcycle and cyclist fleet safety.
- economic development objectives (safety equipment sector)

Key intervention priorities and aspects of institutional delivery

The Commission might consider proposing a recommendation to Member States aimed at reducing the high risk of death through head injury to children when riding bicycles, as well as a consumer information programme for buyers of motorcyclists and cyclist helmets. In some countries, both cyclists and motorcyclist helmets are zero-rated for Value Added Tax and consideration could be given to how this might practice be encouraged.

Consumer information programmes

The UK Safety Helmet Assessment and Rating Programme (SHARP) was launched in 2007 to provide riders with objective safety rating information about the performance of different crash helmets. Differences in performance of as much as 70% have been found between high and low scoring helmets. In the UK, it has been estimated that up to 50 lives could be saved each year if motorcyclists wore the safest helmets (beyond minimum standards) available.[152] Given the success of European safety ratings such as Euro NCAP and Euro RAP, promotion and funded extension of this scheme at EU level (Euro SHARP) could be considered by the Commission, the UK and other interested Member States and partners. It might also be extended to include bicycle helmets.

[152] http://sharp.direct.gov.uk/home

Research into protective safety equipment and clothing

Clothing worn by motorcycles equipped with protective airbag devices hold much promise for reducing injury risk. Further study is required to identify appropriate equipment of this kind in use and its effectiveness in injury prevention.

Recommendations for EU action:

- Set an EU KPI on the proportions of a) motorcyclists, b) moped users and c) pedal cyclists with correct use of a protective crash helmet.
- Work with Member States to monitor and target progress towards these by 2030.
- Bring forward a recommendation promoting the mandatory use of cyclist' helmets for school-aged children and promote use by cyclists in general.
- Establish a European motorcycle helmet consumer information programme along the lines of the UK SHARP programme.
- Establish a European bicycle helmet consumer information programme.
- Promote zero-rated Value Added Tax for cyclist and motorcyclist helmets.
- Carry out research and development into protective clothing for fatal and serious injury prevention.

Recommendations for national action

- Adopt, measure, target, monitor and report progress on a KPI on proportions of the correct use of protective crash helmets by a) motorcyclists, b) moped users and c) pedal cyclists with correct use of a protective helmet.
- Mandate the use of helmets for riders of all sizes of moped.
- Mandate the use of bicycle helmets for children under 14 years old.
- Fund combined publicity and enforcement to increase usage levels of crash helmets.
- Introduce zero-rated Value Added Tax for cyclist and motorcyclist helmets.
- Provide consumer information to buyers of crash helmets to encourage use of those with the highest safety rating.
- Carry out research and development into protective clothing for fatal and serious injury prevention.

Driving without alcohol or other drugs which impair driving

Introduction

It is estimated that 1.5% – 2% of distance travelled in EU Member States are driven with an illegal Blood Alcohol Concentration, but around 25% of all road deaths in the EU are alcohol-related.[153] The ESRA (2016) road user attitude survey revealed that 31% self-reported driving after drinking alcohol in the last 12 months and 12% admitted they had driven when they may have been over the legal alcohol limit at least once in the last 30 days.[154] Road deaths attributed to alcohol were reduced by 46% between 2006 and 2016 in EU25, while other road deaths went down by 40% over the same period. [155] While progress is being made the potential for further savings in deaths and serious injuries is substantial.

[153] European Commission (2015), Alcohol, Directorate General for Transport, https://goo.gl/q1jCS8
[154] Buttler I. (2016) Enforcement and support for road safety policy measures. ESRA thematic report no. 6. ESRA project https://goo.gl/2f1tJp
[155] ETSC (2018). Drink Driving in Europe, Brussels

The influence of prescription and illegal drugs is more difficult to quantify but driving under the influence of some prescription drugs and illegal drugs can lead to a several times increase in crash risk. The DRUID study estimated that illicit and medicinal psychoactive drugs are found in around 15% and 15.5% respectively of road deaths.[156]

Relationship with the prevention and mitigation of death and serious injury

The European Transport Safety Council estimates that at least 5120 deaths would have been prevented in 2016 if all driving had been without alcohol.[157]

Key safety performance indicator

- Proportion of drivers and riders of motorised vehicles without alcohol or other drugs which impair driving.

Assumptions

- *100% driving without alcohol or drugs which impair alcohol.*
- The calculation for safety impact is based on the actual number of alcohol related road deaths, and not on a known risk reduction based on an improved KPI. Hence, this is a cruder assessment than the assessments for the other KPIs.

Safety effect

- When driving in traffic without alcohol or other drugs which impair driving, a reduction of 3379 road deaths in EU28 might be achieved.
-

Alignment with other societal objectives

- public health objectives to prevent and reduce deaths and serious injuries.
- Sustainable transport objectives.
- occupational health and safety objectives.
- safe tourism objectives.
- economic equipment objectives (safety equipment sector)

regional development and neighbourhood objectives.

Key intervention priorities and aspects of institutional delivery

BAC Limits

Blood Alcohol Concentration (BAC) limits provided for in legislation continue to be at the core of efforts to address drinking and driving. The European Commission recommends BAC limits are set at maximum 0.5g/l with a lower limit of 0.2g/l for novice and professional drivers. Most countries have adopted the 0.5 g/l limit, while 0 g/l limit is adopted in the Czech Republic, Hungary, Romania and Slovakia and 0.2 g/l is adopted in Cyprus, Estonia, Poland, Sweden and Norway.

Twenty-two EU countries apply a lower drinking and driving limit for novice drivers (0.0g/l – 0.2g/l) and 19 EU countries apply a lower limit for professional drivers (0.0g/l to 0.2g/l).[157] The Commission could consider including a legislative provision within the driver licensing and professional driving regulatory frameworks in addition to updating it is recommendation.

[156] European Commission 2011, DRUID Deliverable 2.2.5, Prevalence of alcohol and other psychoactive substances in injured and killed drivers, pp. 164-166.

[157] ETSC (2018) Progress in Reducing Drink Driving in Europe, Brussels.

Drug limits

Some countries have introduced limits and roadside checks for illegal and prescription drugs known to impair driving. The UK has for example, introduced limits for eight illegal drugs, including cannabis and cocaine, and higher levels for eight prescription drugs, including morphine and methadone. Those using prescription drugs within recommended amounts are not penalised. Under the legislation, police officers can use "drugalysers" at the roadside to check for cannabis and cocaine. Drivers have to be taken to a police station for a blood test for other drugs including ecstasy, LSD, ketamine and heroin.

Random breath testing and awareness campaigns

Combined high visibility policy and publicity is most important for increasing drivers' and riders' perception of the risk of being detected for excess alcohol and impairment by other drugs to create a deterrent effect. Only the UK, Germany and Malta do not allow random breath testing.

Alcohol interlocks

Studies continue to show that alcohol interlock programmes, combined with rehabilitation programmes, cut reoffending rates both during and after the driver has been required to install the device in their vehicle.[158] Alcohol interlock laws for drink driving offenders and/or professional drivers have been introduced in Austria, Belgium, Denmark, Finland, France, Poland and Sweden. A study commissioned by the European Commission's DG MOVE and published in 2014 concluded that alcohol interlocks can offer effective and cost-beneficial improvement to road safety, particularly for offender and commercial vehicle populations. [159] Consideration might be given to requiring mandatory fitment in EU legislation for these user groups at EU and national levels.

Recommendations for EU action:

- Establish an EU KPI on the proportion of drivers and riders of motorised vehicles without alcohol or other drugs which impair driving.
- Work with Member States to monitor and target progress towards these by 2030.
- Consider a requirement for alcohol and driving limits of (0.0g/l – 0.2g/l) limits for professional drivers and novice drivers within existing EU regulatory frameworks.
- Produce a recommendation on evidence-based approaches to increase the proportion of driving with drugs that impair driving.
- Consider requiring the fitment of alcolocks in new commercial and passenger transport vehicles within EU Whole Vehicle Type Approval.
- Promote the use of alcohol interlocks for repeat excess alcohol offenders.
- Update the recommendation on alcohol and driving in line with best practice on legal limits; combined high visibility enforcement and publicity and related technology and alcohol offender rehabilitation.

Recommendations for national action

- Adopt, measure, target, monitor and report progress on a KPI on the proportion of drivers and riders of motorised vehicles without alcohol or other drugs which impair driving.
- Review blood alcohol and drug limits and their enforcement against good practice and implement revised legislation where necessary.

[158] ETSC (2016) Alcohol Interlocks and Drink Driving Rehabilitation in the EU https://goo.gl/aqGEpM

[159] ECORYS (2014), Study on the prevention of drink-driving by the use of alcohol interlock devices https://goo.gl/U8kBvU

- Adopt alcohol interlocks in national offender schemes to address drinking and driving.
- Require the fitment of alcohol interlocks in public procurement of transport services where appropriate.

Driving without distraction

Introduction

An issue which is increasing in safety priority and which cuts across several Safe System strategic field is the need to address driver distraction. While some mitigation in the long-term by increased automation and driverless cars may be foreseen in the longer term, urgent action will be required in the period to 2030 to reduce distracted driving in the existing vehicle fleet. A growing amount of evidence suggests that distraction whilst driving, in particular by mobile devices such as smartphones, is a factor in causing crashes with serious outcomes.

Relationship with the prevention and mitigation of death and serious injury

Telephone use while driving (whether hand held or hands free) increases the likelihood of being involved in a serious injury crash by a factor of three to four times. Research shows that driver reaction times are 50% slower when telephoning while driving than under normal driving conditions. Studies show that in-car telephone conversations while driving can impair drivers more than listening to the radio or talking to passengers. Roadside surveys in Europe and the United States have shown that between 2% to 5% of drivers use telephones while driving, with many drivers reporting occasional use. Use of a mobile phone while driving is widespread amongst young novice drivers and adds to the problems experienced by this group who already have a higher crash risk.[160] ERSO's report on cellphone use while driving suggests that between 5% to10% of all road deaths can be attributed to mobile phone use.[160]

Key safety performance indicator

- Proportion of drivers without use of in-car telephones.

It is recommended that observational studies of actual in-car telephone use in normal traffic are used for this indicator rather than self-reporting methodologies.

Assumptions

- 100% driving without the use of an in-car telephone.
- the safety effect has been estimated on the basis of a 7% fatality reducing effect given the precise risk relationship between use of car phones and the risk of death is not yet identified.

Safety effect

- It is estimated that 100% driving without the use of an in-car telephone would prevent around 1817 car occupant road deaths.

Key intervention priorities and aspects of institutional delivery

Few EU countries conduct systematic surveys of car telephone use by drivers. Roadside surveys in Europe and the US have shown that between 1% to 11% of drivers use telephones while driving, with many drivers reporting occasional use. Interventions regarding mobile phone use need to address hand-held and hands-free

[160] European Commission, Cell Phone Use While Driving, ERSO European Commission, Directorate General for Transport, September 2015.

phones. There is little research-based information at present concerning effective intervention though substantial studies looking at aspects of distraction are currently underway within the Horizon 2020 programme.[160]

Enforcement and information campaigns

Drivers need to be made more aware of the dangers of mobile phone use and of other various distracting activities and educated about the possible effects of distraction, their ability to compensate for it, as well as receiving practical advice on how to deal with telephones in vehicles. If the detection of hands-free telephoning while driving is difficult to enforce by conventional means (although police have opted to use visual aids in some jurisdictions), in-vehicle enforcement through technological means provides an alternative future option.

Better hands-free design

Ultimately, the most effective solutions are likely to be in-vehicle interventions. The human-machine interface of in-car information systems and telephones needs to be designed as ergonomically as possible to allow safe use such as automatic postponement of the connection of incoming calls and designing complex human-machine interfaces that would regulate driver use of in-vehicle systems.

Recommendations for EU action:

- Set a KPI on the proportion of drivers without use of in-car telephones.
- Work with Member States to measure, target and monitor progress on this indicator to 2030.
- Act on promising intervention to emerge from Horizon 2020 research and development.
- Require vehicle manufacturers to demonstrate compliance with the HMI Guidance Statement of Principles on in-vehicle information and other information systems.
- Carry out on-going research into distraction and effective intervention.

Recommendations for national action

- Adopt, measure, target, monitor and report progress on a KPI on the proportion of users driving without use of in-car telephones.
- Fund combined publicity and enforcement of rules on telephone use while driving.
- Carry out research into distraction and effective intervention.

4.4 Recommended work for further development of the 2020-2030 strategy

In planning to launch the new strategy in 2018, the European Commission has taken into account the need for further preparation of elements of the strategy to allow the start of implementation in 2020. The following activities to be carried out between now and 2020 are recommended:

- Project activity to prepare the further definition and measurement of new EU key safety performance indicators, measurement protocols and possible targets 2020-2030 (to be announced in 2020) to be agreed by the CARE group reporting to the High-Level Group on Road Safety and the European Commission.

- Work to prepare definition and guidance for policymaker and practitioners at EU and national levels on the new EU key road safety performance indicators to 2030.
- Work to specify measurement methods and protocols.
- Work to prepare baseline measurements for 2020.
- Work to set targets to 2030 based on established 2020 baselines.

- Project activity to identify specific targeted, cost-effective EU investment in road safety especially in needy areas where there is specific EU competence. This might take place within the new Safer Roads Fund or other financial incentive scheme, if established before 2020 and would include:

  - Updated risk-mapping of the comprehensive TEN-T network.
  - Work to identify and prepare intervention on a series of simple demonstration projects on specific high-volume, high-risk corridors of the comprehensive eastern TEN-T network.
  - Work to identify a carefully structured sample of Star Ratings particularly biased towards the less homogeneous roads and the highest risk roads revealed by Risk Mapping for the comprehensive TEN-T network.
  - Support for development of some simple software as part of the VIDA tool for 'user defined investment plans' to encourage knowledge transfer and self-help for engineers.

- Project activity related to road safety management capacity at EU level. The aim would be to carry out:
  - Work to engage with a range of Commission Directorates to review readiness for action for new shared responsibility for road safety and to establish co-benefits with other societal objectives e.g. transport, health, occupational health and safety, industry, environment. Identify possible new strategic functions for the High-Level Group on Road Safety.
  - Work to define arrangements for the engagement of key stakeholders at EU level in contributing to a range of measurable performance objectives and reporting in Annual Results Conferences on their contributions.

LIST OF ANNEXES

ANNEX 1: Summary of SAE International's Levels of Driving Automation for On-Road Vehicles

ANNEX 2: Methodology for estimating the effects of recommended KPIs and summary of results

ANNEX 3: EU Road Safety Activity 2015-2017

ANNEX 4: Summary of Recommendations

Annex 1: Summary of SAE International's Levels of Driving Automation for On-Road Vehicles Issued January 2014, SAE international's

J3016.http://www.sae.org/misc/pdfs/automated_driving.pdf

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Annex 2: Methodology for estimating the effects of the recommended KPIs and summary of results

1 Methodology

An outline is presented below of the methodology used by SWOV for estimating the effects of the recommended KPIs. The methodology for the KPI on road infrastructure is provided by the Road Safety Foundation and is also briefly outlined.

The authors cannot emphasise too strongly that owing to the deficiencies in a range of data needed for analysis of the potential effects of KPIs on EU road fatality and serious injury numbers, the assessments made are, at best, very rough estimates.

While research study estimates may vary, cautious estimates have generally been used here in estimating fatality risk-reducing effects.

Note that KPI is used synonymously with SPI in this annex.

The SPI/KPI-model used by SWOV

For a KPI to be effective, a clear definition is needed as well as identification of measures and relationship with a specific group of road crash casualties.

In this analysis, for each candidate KPI (or family of KPIs) possible definitions, and possible groups of road crash victims that can be related to this KPI (i.e. saved when the KPI increases to a sufficient level) are identified. The conceptual model depicted in Figure A2.1 is used.

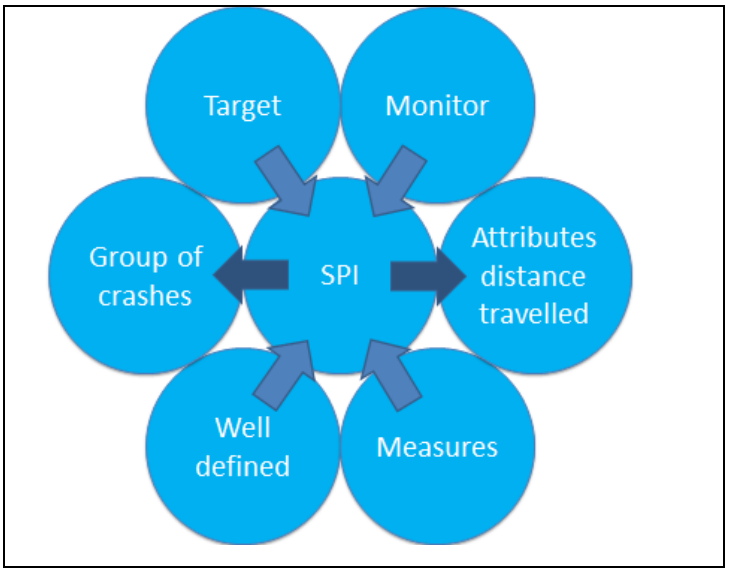

Figure A2.1. *Setup of the different relevant properties of an effective Safety Performance Indicator (SPI)*

This requires the following steps:

1. Define the KPI in a quantitative way, preferably such that it is a proportion of travel that is in agreement with safe conditions. When the KPI equals 100%, it is optimal.
2. Identify the type of crash for which this KPI is expected to effectively reduce crashes or casualties or injuries.
3. Estimate the number of road deaths associated with this type of crash (by country or group of countries)
4. Identify realistic measures (by country or group of countries)
5. Estimate the current level of the KPIs (by country or group of countries)
6. Estimate the possible effect of the KPI, given some current level and a possible future target level of the KPI, in terms of the expected decrease in the number of road deaths (by country or group of countries).

The effect of increasing KPIs on the number of road deaths

Estimate based on known risk reduction

Suppose there is a group of N_{SPI} deaths for which a specific KPI is effective. Suppose we know this KPI to reduce the number of road death by f_{SPI}, i.e. a proportion of (1- f_{SPI}) of the relevant road deaths remains when the KPI equals 100%. Note that the *reduction* f_{SPI} is defined as a positive number.

If the KPI equals 0, this means that an increase of this KPI from 0 to 1 would yield a lower number of road deaths, namely $f_{SPI} \cdot N_{SPI}$.

When the KPI has improved to a current level of, say, KPI_1, the relevant number of road deaths in that group (of originally N_{SPI}) road deaths, has subsequently decreased to a new and lower level, say N_1. This number is determined by f_{SPI}, N_{SPI}, and KPI_1:

$$N_1 = (1\text{-}f_{KPI} \cdot KPI_1) \cdot N_{KPI} \qquad \text{Eq. 2.1}$$

Figure A2.2 is an illustration of the effect of an KPI (running from 0 to 1, i.e. from 0% to 100%), if this SPI reduces the number of relevant road deaths by 0.4 (or 40%) (i.e. f_{SPI} = 0.4). The figure shows the *proportion n* of road deaths (i.e. $n_{SPI} = N_{SPI}/N_{SPI=0}$) that remains for every value of the KPI.

When the current value of an KPI equals KPI_1, and this value improves to KPI_2, this yields a change in the number of road deaths from N_1 to N_2. Hence, the road safety improvement, $\Delta N = N_1\text{-}N_2$, which is a negative number, can be estimated with straightforward mathematics.

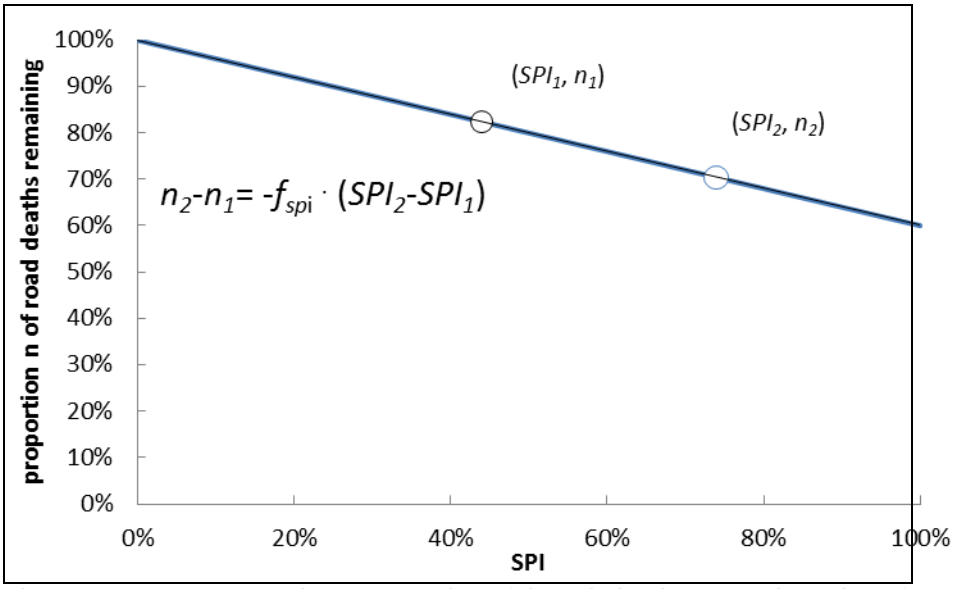

Figure A2.2 *A conceptual representation of the relation between the value of an SPI, and the proportion (n) of road deaths that corresponds to different values of this SPI. Here, the proportion of deaths (n) is shown as a function of the SPI, assuming a safety effect of 40%, where n = N_{SPI}/N_0, the value where the SPI=0.*

$$\Delta N = N_2 - N_1 = - f_{SPI} \cdot (SPI_2 - SPI_1) \cdot N_{SPI} \qquad \text{Eq. 2.2}$$

We need the minus sign in Eq. 2.2 as f_{SPI} is defined as a positive number and ΔN is a negative number; it is a decrease.

Eq. 2.2 requires that we know N_{SPI}. This value can be deduced from Eq. 2.1:

$$N_{SPI} = N_1 / (1 - f_{SPI} \cdot SPI_1) \qquad \text{Eq. 2.3}$$

Combining Eq. 2.2 and Eq. 2.3 yields:

$$\Delta N = N_1 - N_2 = - f_{SPI} \cdot (SPI_2 - SPI_1) \cdot N_1 / (1 - f_{SPI} \cdot SPI_1) \qquad \text{Eq. 2.4}$$

Mark that the subscript $_1$ denotes the current level and the subscript $_2$ refers to a target level in a future year.

With Eq. 2.4 the decrease in a relevant group of crashes as a result of an increase of the corresponding KPI can be estimated.

Mark that although the theory is straightforward, indication of the relevant group of road deaths, applying a correct value of the effect of the KPI, and measuring the KPIs accurately for all Member States can be challenging.

Estimate based on the size of the relevant group of crashes

In case the relevant number of crash victims that can be associated with the KPI<1 is known (e.g. in case of high BAC), under the condition that this group will reduce to zero when the relevant KPI

is improved to 100%, the effect of the KPI can be deduced from the size of that group of crash victims.

However, in many cases this is an uncertain approach, as it is often not known if this condition is met. E.g. for seat belts, it is unclear how many of the current car occupant deaths not wearing a seat belt, would have died anyway even with a seat belt (because these occupants may also have speeded, used alcohol etcetera).

Anyway, when we know the relevant number of road deaths in this group, N_{group} , this number can be taken as the desired value of ΔN (if the SPI_2=100%). If SPI_2<100%, ΔN would be a proportion of N_{group}, according to

$$\Delta N = (SPI_2 - SPI_1) / (1-SPI_1) \cdot N_{group} \qquad \text{Eq. 2.5}$$

In case that the number of road deaths saved is known, as well as the KPI values, an estimate can be made of the effect of the measure f_{SPI}.

$$\Delta N \cdot (1-f_{SPI} \cdot SPI_1) + f_{SPI} \cdot (SPI_2 - SPI_1) \cdot N_1 = 0 \qquad \text{Eq. 2.6}$$

$$f_{SPI} \cdot (SPI_2 - SPI_1) \cdot N_1 - \Delta N \cdot f_{SPI} \cdot SPI_1) = - \Delta N \qquad \text{Eq. 2.7}$$

$$f_{SPI} = - \Delta N / [(SPI_2 - SPI_1) \cdot N_1 - \Delta N \cdot f_{SPI} \cdot SPI_1)] \qquad \text{Eq. 2.8}$$

2 Data and other sources

Road death data

This analysis is largely based on the available data in CARE. Data are not corrected for known incompleteness (such as the additional number of road deaths in the Netherlands not reported to CARE). We used a table of deaths, stratified by travel mode and age group. Estimates of the current situation are based on the last three available years, which are 2012-2014 for Ireland, 2013-2015 for Belgium, Bulgaria, Cyprus, Czech Republic, Estonia, Finland, Lithuania, Malta, Netherlands, Poland, Slovakia, Spain and United Kingdom (13 countries) and 2014-2016 for Austria, Croatia, Denmark, France, Germany, Greece, Hungary, Italy, Latvia, Luxembourg, Portugal, Romania, Slovenia, Sweden (14 countries). Data was extracted from CADaS on December 15, 2017.

Population (demographic) data

Data up to 2012 were used for demographic data stratified by age and 2015 data were used for totals for all ages.

KPI data

KPI data are not collected and managed on a structural basis. For some KPIs the European Transport Safety Council publishes information based on data reported by a panel with representatives from more than 30 countries in Europe. Also, some other sources are available, such as FIA fact sheets and the ESRA survey based on self-reported behavior. KPI information was used which seemed sufficiently reliable, comparable over countries and (publicly) available.

For the specific KPIs we used the publications as indicated in the following paragraphs as general reference. Further specific references are included in later sections.

KPI Seat belts

ETSC PIN flash 27 (car occupant safety)
ETSC PIN flash 31 (enforcement)
ESRA thematic report on seat belt and child restraint systems
https://www.swov.nl/sites/default/files/publicaties/gearchiveerde-factsheet/uk/fs_seatbelts_archived.pdf

KPI Child restraints

ETSC PIN flash 27 (car occupant safety)
ETSC PIN flash 34 (child safety; not yet published)
ESRA thematic report on seat belt and child restraint systems
https://www.swov.nl/sites/default/files/publicaties/gearchiveerde-factsheet/uk/fs_seatbelts_archived.pdf

KPI Helmet use

https://www.swov.nl/en/facts-figures/factsheet/moped-and-light-moped-riders
FIA country sheets.

KPI Distraction by in-car telephone use

ETSC PIN flash 31 (enforcement)
ESRA thematic report on distraction and fatigue

KPI Drink- (and drug) driving
ETSC PIN flash 31 (enforcement)
ESRA thematic report on drink driving

KPI Speed
ETSC PIN flash 28 (motorway safety)
ETSC PIN flash 31 (enforcement)
ESRA thematic report on speed
Some speed limit data are taken from 2017 EC Statistical pocket book.

KPI Euro NCAP
ETSC PIN flash 27 (car occupant safety)
ETSC PIN flash 30 (how safe are new cars)

Location specific KPIs

KPI Emergency Medical Services
Literature on spatial allocation of ambulances (e.g. Ngoc -Hien Thi Nguyen, Quantitative Analysis of Ambulance
Location -allocation and Ambulance State Prediction;
https://www.diva-portal.org/smash/get/diva2:781472/FULLTEXT01.pdf)
No resources on data known to the authors, neither on average time between call and arrival of the Ambulance, nor ambulance fleet size.

KPI Road infrastructure
Provided by Road Safety Foundation, Euro RAP 2017, 2018.

3 Summary of results

A summary of the analysis on the recommended KPIs and their effectiveness is outlined.

Definition: issues regarding possible definitions, or problems with current definitions

Monitoring: relevant data to be gathered and monitored uniformly

Risk reducing effect: the effect on reducing fatality risk.

Target: possible appropriate targets for this KPI

Estimated number of EU road deaths saved (100%)

Key references used: General reference for estimates are provided. All reference hyperlinks accessed on 23.3.18.

3.1 KPI: Seat belts

Definition: Proportion of motor vehicle occupants using a seat belt in a) front seats and b) rear seats This option is identified as the most effective combination for a seat belt KPI to enhance road safety.

Monitoring: KPI data are not collected systematically. Some data is available to allow rough estimation of the current KPI level.

Method: based on eq. 2.5

- N_{group} = number of people killed as car occupants, aged 10+ yr. For BG and SK this number was not available in CARE and estimated to be the same proportion of all deaths in those countries, as the average proportion in the remaining 26 of the EU 28 countries.
- KPI_1 = based on PIN FLASH 31 (ETSC), for countries with available data. Remaining countries: the unweighted average SPI value of the countries available.
- KPI_2 = 100%
- Calculation carried out for each individual EU 28 country

Key references used:

- ETSC PIN flash 27 (car occupant safety)
  http://etsc.eu/ranking-eu-progress-on-car-occupant-safety-pin-flash-27/

- ETSC PIN flash 31 (enforcement)
  http://etsc.eu/how-traffic-law-enforcement-can-contribute-to-safer-roads-pin-flash-31/

- ESRA thematic report on seat belt and child restraint systems
  https://www.vias.be/publications/ESRA%202015%20Thematic%20Report%20No%204%20SeatBelt%20AND%20Child%20Restraint%20Systems/ESRA_2015_Thematic_Report_No_4_SeatBelt_AND_Child_Restraint_Systems.pdf

- Elvik at al, 2009. The Handbook of Road Safety Measures.
- SWOV Factsheet (2012) https://www.swov.nl/sites/default/files/publicaties/gearchiveerde-factsheet/uk/fs_seatbelts_archived.pdf

Risk reducing effect: We assumed an estimated 40% reduction in fatality risk.

Target: We selected a 90% target and a 100% target for all seating positions.

Estimated number of EU road deaths saved (90%): -444.

Estimated number of EU road deaths saved (100%): -905.

3.2 KPI: Child restraints

Definition: Proportion of correct use of child restraints by child occupants
The required restraints are not uniform across EU28. Different restraints are appropriate for babies, toddlers and older children.

Monitoring: differences in requirements between countries are insufficiently reflected in the observations of this SPI.

Method: based on eq. 2.5

- N_{group} = number of people killed as car occupants, aged 0-9 yr. For BG and SK this number was not available in CARE and estimated to be the same proportion of all deaths in those countries, as the average proportion in the remaining 26 of the EU 28 countries.
- KPI_1 = based on PIN FLASH 31 (ETSC), for countries with available data. Remaining countries: the unweighted average SPI value of the countries available.
- KPI_2 = 100%
- Calculation carried out for each individual EU 28 country

Key references used:

- ETSC PIN flash 27 (car occupant safety) http://etsc.eu/ranking-eu-progress-on-car-occupant-safety-pin-flash-27/
- ETSC PIN flash 34 (child safety) http://etsc.eu/reducing-child-deaths-on-european-roads-pin-flash-34/
- ESRA thematic report on seat belt and child restraint systems https://www.vias.be/publications/ESRA%202015%20Thematic%20Report%20No%204%20SeatBelt%20AND%20Child%20Restraint%20Systems/ESRA_2015_Thematic_Report_No_4_SeatBelt_AND_Child_Restraint_Systems.pdf
- Elvik at al, 2009. The Handbook of Road Safety Measures.
- SWOV Factsheet Motorcycle and moped helmets (2010) file:///C:/Users/Owner/Downloads/fs_helmets_archived%20(2).pdf

Risk reducing effect: We assumed a 50% reduction of risk of fatal injury.

Target: We selected a 100% target, assuming the effectiveness to be uniform for all ages.

Estimated number of road deaths saved: -31.

3.3 KPI: Helmet use

A: Powered two-wheeler user helmets

Definition: Proportions of a) motorcyclists and b) moped users with correct use of a protective helmet.

Monitoring: Currently, monitoring is quite poor. Uniform data of helmet use (and legislation) is not available. For 11 countries there is no data; for several others there are data for drivers only, sometimes there are data regarding self-reported wearing, which are quite deviant from estimated values.

Method: based on eq. 2.5

- N_{group} = number of people killed as a moped rider, motorcycle rider or rider of another two-wheeled motor vehicle. For BG and SK this number was not available in CARE and estimated to be the same proportion of all deaths in those countries, as the average proportion in the remaining 26 of the EU 28 countries.
- KPI_1 = based on FIA country sheets, for countries with available data. Remaining countries: the unweighted average SPI value of the countries available.
- KPI_2 = 100%
- Calculation carried out for each individual country

Key references used:

WHO helmet use good practice manual (http://www.who.int/roadsafety/projects/manuals/helmet_manual/1-Why.pdf), http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004333.pub3/abstract;jsessionid=25D55A4D38FBFF981EA49058F628B9E0.f02t01).

FIA country data sheets (unpublished).

Risk reducing effect: We assumed a 40% reduction in PTW user fatality risk.

Target: We assumed that an appropriate target could be 100%.

Estimated number of road death saved: -202.

B: Bicycle helmet use

Definition: Proportions of cyclists with correct use of a protective helmet.

Monitoring: Currently, monitoring is completely lacking. Uniform data of bicycle helmet use is not available. Legislation is rare with the majority of EU countries having no legislation in helmet use. Note that a mandatory use requirement is not automatically implied by the adoption pf the KPI.

Method: based on eq. 2.5

- N_{group} = number of people killed as a cyclist (=2051). For BG and SK this number was not available in CARE and estimated to be the same proportion of all deaths in those countries, as the average proportion in the remaining 26 of the EU 28 countries. Result: an estimated 2125 bicycle deaths annually.
- KPI_1 = 5%
- KPI_2 = 100%
- Calculation carried out for EU 28 in one go, as no individual KPI-values were available,

Key references used:

- Olivier J and P Creighton, 2016: Bicycle helmets ad helmet use: a systematic review and metanalysis: In International Journal of Epidemiology.
- Kullgren, A., M. Rizzi, H. Stigson, A. Ydenius and J. Strandroth. 2017. The potential of vehicle and road infrastructure interventions in fatal pedestrian and bicyclist accidents on Swedish rural roads –what can in-depth studies tell us? 25th ESV Conference, 2017 Detroit. Paper number 17-0284
- Bíl et al. (SafetyScience 2018, 71-76)
- Persaud et al. (CMAJ 2012. DOI:10.1503/cmaj .120988

Risk reducing effect: We assumed -36% in bicycle user fatality risk taking into account that while the effectiveness of reducing head injury is higher per se (around 65%), the overall injury severity is also influenced by fatal injury to other parts of the body. This assessment is based on the estimation by Olivier et al (that 65% of all cyclists who die from a fatal head injury, could have been saved wearing a helmet. As not all cyclists die from fatal head injury, the actual effect of wearing a helmet is less than 65%. Unfortunately, much less is known of the proportion of cyclists dying from head injuries. Based on publications from Bíl et al. and Persaud et al. we can derive that 55% of all killed cyclists have fatal head injuries, arriving at a 36% overall effect of bicycle helmets in reducing death risk.

Target: We assumed that an appropriate target could be 100%.

Estimated number of road death saved: -740.

3.4. KPI: Distraction by mobile phone use

Definition: Proportion of drivers without use of in-car telephones.

Monitoring: In line with ERSO's report, a monitoring program of mobile phone use in the EU is urgently needed.

Method: based on the number of deaths associated with mobile phone use by car drivers (5%-10%, according to ESRA reports). It is not possible to use eq. 2.5, since neither the increases in risk nor the current values of this SPI are insufficiently well known.

- N_{group} = number of road deaths associated with mobile phone use. Assuming 7%, this amounts to 1817 road deaths.
- KPI_1 = not well known, but roughly estimated to be 98% (i.e. 2% of distance travelled drivers are distracted by mobile phone use)
- KPI_2 = 100%
- Calculation carried out for total EU 28

Key references used:

- ETSC PIN flash 31 (enforcement) http://etsc.eu/how-traffic-law-enforcement-can-contribute-to-safer-roads-pin-flash-31/

- ESRA thematic report on distraction and fatigue https://www.vias.be/publications/ESRA%202015%20Thematic%20Report%20No%203%20Distraction%20AND%20Fatigue/ESRA%202015%20Thematic%20Report%20No%203%20Distraction%20AND%20Fatigue.pdf

Risk reducing effect: Risk increasing factors of between 4 (phone calls) and 25 (looking at the screen) are mentioned for mobile phone use, yielding risk reducing factors of non-use of -25% to -7%. In our method risk reduction parameters were not used to estimate the results. Instead ESRA estimates of the proportion of deaths associated with mobile phone use was applied

Target: We assumed 100% compliance, i,e, road users do not use their mobile phone while driving or riding.

Estimated number of road death saved: -1817.
Based on reported proportions of road deaths in the USA and Sweden, we may expect a reduction in the number of road deaths of 5%-10% in Europe, when phones are no longer used while driving or riding. This yields a reduction of 1817 in road deaths, based on a 7% reduction. However, where nothing is done, the death rate may increase instead, thereby increasing the possible road safety gain of this SPI.

3.5 KPI on Drink driving

Definition: Proportion of drivers and riders of motorised vehicles without alcohol or other drugs which impair driving.

Monitoring: Use of this KPI requires regular observation of the proportion of drivers within the limit. In order to be able to estimate the effect of this KPI, it is also necessary to measure the distribution of BAC among the drivers that do not comply with the (legal) limit. Note that no estimate for the effect of the KPI relating to use of drugs other than alcohol given the complexities associated with the range of drugs in use and the lack of available data.

Method: based on the number of deaths associated with drink driving, according to ETSC's PIN FLASH 31, and the underlying data provided by ETSC. It is not possible to use eq. 2.5, because then we would also need to know the distribution of BAC of all drivers with a BAC above the limit.

- N_{group} = number of road deaths associated with drink driving. This amounts to 3379 road deaths.
- KPI_1 = not well known, but roughly estimated to be 98% (i.e. 2% of distance travelled drivers have a BAC above the limit)
- KPI_2 = 100%
- Calculation carried out for EU 28 as a whole.

Key references used:

- ETSC PIN flash 31 (enforcement)
  http://etsc.eu/how-traffic-law-enforcement-can-contribute-to-safer-roads-pin-flash-31/

- ESRA thematic report on drink driving
  https://www.vias.be/publications/ESRA%202015%20Thematic%20Report%20No%202%20DUI%20Alcohol%20AND%20Drugs/ESRA%202015%20Thematic%20Report%20No%202%20DUI%20Alcohol%20AND%20Drugs.pdf

Risk reducing effect: The risk reducing effect depends on the (currently unknown) distribution of BAC above the legal limit. Risk increase is known to be very high for drivers with a high BAC (e.g. a factor 200 for people with more than 2.3 g/ℓ alcohol in their blood). This risk reduction was not used in the estimate of the number of deaths associated with this KPI

Target: We assumed 100% compliance with the legal limit.

Estimated number of road death saved: -3379.
Based on data regarding the number of casualties in alcohol related crashes, this could yield 3379 road deaths saved. This estimate is based on a different reasoning from that used on assessing the potential impact of other KPIs and should be interpreted with care.

3.6 KPIs on Speed

Definition: Proportion of traffic volume with drivers travelling within the speed limit on urban roads, rural roads, motorways, TEN-T network; Proportion of traffic volume on urban, rural, motorways, TEN-T roads within speed limits which are 'safe and credible'

Monitoring: To estimate the effect of speed changes, we need to know the following variables:

1. Proportion of distance travelled of vehicles complying to the speed limit (by speed limit).
2. Average speed (by speed limit)
3. Distribution of speed for vehicles driving faster than the speed limit (e.g. based on violation fine data)
4. Number of road deaths by speed limit.
5. Preferably: the proportion of roads (weighted by traffic volume) with a safe and credible (SaCred) speed limit.

Method: Based on data deficiencies the assessment method used is very crude; based on eq. 2.5 for motorways, the result adjusted and extended to all roads.

- N_{group} = All crashes in EU 28.
- KPI_1 = Based on ETSC's PIN FLASH 28 for motorways
- KPI_2 = 100%
- Calculation carried out for EU 28 in one go.

Key references used:

- ETSC PIN flash 28 (motorway safety)
  http://etsc.eu/ranking-eu-progress-on-improving-motorway-safety-pin-flash-28/

- ETSC PIN flash 31 (enforcement)
  http://etsc.eu/how-traffic-law-enforcement-can-contribute-to-safer-roads-pin-flash-31/

- ESRA thematic report on speed
  https://www.vias.be/en/research/notre-publications/esra-2015-thematic-report-no-1-speeding/

- Nilsson G. (2004) Traffic safety dimensions and the power model to describe the effect of speed on safety. Bulletin 221, Lund Institute of Technology, Lund

- Elvik R, Christensen P, Amundsen A, (2004) Speed and Road Accidents, an evaluation of the Power Model, TOI, Oslo.

- Some speed limit data are taken from 2017 EC Statistical pocket book.
  https://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2017_en

Risk reducing effect:
In our assessments we made a crude assumption that all vehicles that violated the speed limit drove 15% faster than the limit. Based on Nilsson's fourth power risk increase with speed increase, this yields a 60% risk decrease for those vehicles. Note that we did not distinguish between travel modes, road design etc. and that the estimation of the effect may be less as it is usually applied to average speed of all vehicles, and not to average speed of vehicles violating the limits.

For the risk reduction for motorways (with ETSC data of violations and limits) we estimated a risk reduction of 37%. Assuming that for many other roads speeds are less often the main cause of fatal crashes (think of crashes with vulnerable road, crashes during dark, etc.) we used an overall reduction in the number of road deaths of 25%.

Target: We assumed 100% compliance with speed limits for motorways (the only road type for which some data were available. Again, we assume these speed limits are in agreement with the road design of Motorways. I.e. roads with a high-speed limit are *assumed* to be designed more safely than roads with a low limit.

Estimated number of road deaths saved: -6489.

Countries, for which data of compliance and road deaths are available (for motorways), a 37% decrease for motorways was assessed) when this reduction is applied to all countries (including Germany), a reduction of 686 deaths would be possible.

We did not specifically calculate any possible effects for other roads. As the relation between speed and risk changes toward a smaller power for lower speeds (according to Elvik's results), we cannot assume that the risk reduction will be of the same order of magnitude when vehicles comply to speed limits on all roads, as for motorways. Further, we have limited view from available data on the actual compliance on most other European roads. A general effect of speed limit compliance on the number of road deaths is likely to be somewhat less than 37% (although there is no way to accurately decide upon this). We propose to assume a 25% reduction in general i.e. -6489.

3.7 KPI on Euro NCAP

Definition: Proportion of new passenger cars with a 5-star Euro NCAP rating for new registered cars.

Risk reducing effect: we assumed a risk reducing effect of $n \cdot f_{star}$, where n is the number of stars. We assume f_{star} = 0.1, i.e. a 10% reduction per star, yielding 50% risk reduction for a 5-star car, as compared to no stars.

Method: Very complex, because the KPI "proportion of newly sold 5-star vehicles is actually a pseudo KPI. To know the effect of this KPI on the number of road deaths, we need to translate this pseudo KPI to the unknown, but essential actual KPI: the number of cars with a 5-star Euro NCAP rating.

- N_{group} = All fatalities of car occupants.
- *Pseudo* KPI_1 = Based on ETSC's PIN FLASH 30
- *Pseudo* KPI_2 = 100%
- Actual KPI based on pseudo KPI: An estimate was made of the actual composition of the fleet of every country, by age, and by number of stars, based on the following assumptions.
  - Average age of vehicles as observed in 2013 (in individual countries) is assumed valid in all years (in past and future).
  - Even without EU policy in this area and assuming new vehicles will have the current Euro NCAP scores, the safety of the vehicle fleet will increase as old vehicles (without Euro NCAP scores) will be gradually replaced by newer cars). This effect will lead to fewer and fewer road deaths and is denoted as "natural decay".
  - The increase in the distribution of scores over the new fleet is assumed to gradually increase to 100% 5-star in 2030 (based on current and not future Euro NCAP rating. No future trends and measures are incorporated.
  - An average vehicle lifetime of 21 years is assumed, based on the average renewal rate of 4.8% in Europe. This probably is an overestimation, because this renewal rate is based on data gathered in a period of recession.
  - Countries with a higher renewal rate are supposed to export the cars at the average lifetime valid for the vehicles in these countries.

  - Countries with a lower renewal rate are assumed to import second hand cars at the average age of all vehicles that are exported by the countries with a high renewal rate.
  - Vehicles with an Euro NCAP rating older that 2010 or with no rating are considered to have a rating of 0-stars.
  - Rates since 2010 are considered to be of equal effectiveness.
- For Croatia, Luxembourg and Malta, there are no pseudo SPI data available. For the remaining countries, an estimate of the proportion of car occupant road deaths was estimated. This proportion was also applied for the three countries with no SPI data.
- Calculations of the SPI were carried out for individual countries, by first estimating the composition of their fleet by age and hence by Euro NCAP ratings (based on the pseudo SPI according to ETSC's PIN FLASH 30). This yields an average rating for the fleet of every MS and every year from 2010.
- Calculations of the safety effect were based on two scenarios.
  1. Nothing is done to improve the ratings, and ratings remain equal to those in 2013; this yields a gradual increase in safety, denoted as the "natural decay".
  2. The average ratings linearly increase between 2020 and 2030 from the values represented in the PIN FLASH in 2020 to 100% 5-star cars in 2030. This yields a reduction in the number of road deaths that is larger than the natural decay.
- The difference between 1. and 2. Is considered the effect of the improvement of this KPI.
- Mark that the actual KPI may be considerably better than that in 2013. The consequence of this is that part of the reduction estimated in 1. has been achieved already, and the effect of an increase KPI will be less.

Monitoring: New car properties can be monitored by Euro NCAP as this is currently carried out. However, we also need car fleet composition information by member state, which is currently not available.

Target: We selected a 100% tested and 5-star rated level *for new cars*, while this level starts to increase in 2020, with a 10% improvement annually. This assumption is needed. If the proportion of tested and rated cars remains at the level of 2013, we may expect a decrease in the number of car occupant road deaths of 2641, due to the expected gradual increase in the proportion of well rated cars all over Europe. When the pseudo SPI gradually increases after 2020 to 100%, an extra 658 deaths are expected to be saved in 2030 (and more in the years after that).

Key references used:

- ETSC PIN flash 27 (car occupant safety)
  http://etsc.eu/wp-content/uploads/pin_flash_27_v2.pdf

- ETSC PIN flash 30 (how safe are new cars)
  http://etsc.eu/how-safe-are-new-cars-sold-in-the-eu-pin-flash-30/

Estimated number of road deaths saved: -3295

3.8 KPI: Emergency medical services

Definition: Proportion of seriously injured road crash victims with access to professional medical assistance within 15 minutes of notification.

Monitoring: The monitoring of this KPI requires strong improvement. A simple way is for ambulance organisations to monitor this, and not just for city trips but for all trips. In case definitions differ between countries, or between city trips and other regions, it is still possible to estimate this SPI, if countries monitor all response times, and are willing to do the calculations according to an EU definition.

Method: based on the SafetyNet estimate that between 10% and 13% of all road deaths could be saved if all victims received medical attention within 15 minutes.

- N_{group} = all deaths.
- SPI_1 = not known
- SPI_2 = 100%
- Calculation carried out for EU 28 as a whole.

Key references used:

- SafetyNet: State of the art Report on Road Safety Performance Indicators http://www.dacota-project.eu/Links/erso/safetynet/fixed/WP3/Deliverable%20wp%203.1%20state%20of%20the%20art.pdf

- Rocío Sánchez-Mangas, Antonio García-Ferrer, Aranzazu de Juan, Antonio Martín Arroyo. "The probability of death in road traffic accidents. How important is a quick medical response?" Accident Analysis and Prevention 42 (2010) 1048.

- Literature on spatial allocation of ambulances (e.g. Ngoc -Hien Thi Nguyen, Quantitative Analysis of Ambulance Location -allocation and Ambulance State Prediction; https://www.diva-portal.org/smash/get/diva2:781472/FULLTEXT01.pdf)

- No resources on data across EU countries known to the authors, neither on average time between call and arrival of the Ambulance, nor ambulance fleet size.

Risk reducing effect: The risk reduction related to a change from the current (largely unknown) situation to a situation with a 15-minute standard response time, is unknown.

Target: The ultimate, though very ambitious, target could be to establish optimal emergency medical treatment which means that 100% of all ambulance trips are within 15 minutes of the call.

Estimated number of road death saved: -2600.
An overall reduction of 10%-13% was estimated when emergency medical care is always optimal. This reduction can be seen as an upper limit of the road safety reduction effect of this KPI.

3.9 KPI: Road infrastructure TEN-T comprehensive network

The assessment of the value of the indicator for the TEN- T comprehensive network has been provided by Euro RAP analysis, using a different methodology. EuroRAP analysis indicates that if 100% travel is achieved on 3-star roads on the TEN-T comprehensive network (core network plus connecting roads) the fatality saving would be 864 per year (of the total 2812 killed). If 100% of travel is achieved on 4-star roads all TEN-T comprehensive network, then some 2029 lives might be saved annually. This latter estimate is used.

The methodological process involved consideration of:

- sample networks surveyed and the version of the protocol they were coded to;
- a grossing up to the Star Rating distribution for 'western' and 'eastern' Europe on the common V3 iRAP protocol
- the derivation of the length of network in each star rating band
- the derivation of AADTs from either Star Rating or Risk Mapping data sources
- the fatality estimation taking into account flows and the risk rate for a given Star Rating and country income
- grossing up to an improved Star Rating distribution on the basis of the known KSI rate in the country for 3-star rather than 1- or 2- star; or for 4-Star rather than 3-Star to provide rough estimates of savings.

Provided by Road Safety Foundation, Euro RAP 2017, 2018.

4 Serious road injuries

4.1 Introduction

In 2013, the EU introduced a common European definition of a serious road injury, i.e. a road crash victim who is treated in a hospital, has an injury severity of MAIS 3 or more, and does not die as a consequence of the crash within 30 days.

This is a major step forward, as up until recently, and in some countries still, the definition of a serious road injury could mean different things. E.g. the definition could comprise any injury, or injuries treated in hospital, or hospitalized (either actually or as perceived by police officers according to their interpretation of the injury at the scene of the crash). This results in a wide variety of different definitions of serious injuries. In 2018, the new definition has not yet found its way into general implementation, although many member states are actively working on the collection of police data, hospital data, data matching etc. in order to meet the EU requirements.

Perez et al (2016) found that practices concerning the estimation of the number of MAIS3+ casualties differ between countries and that methodological differences can have a considerable effect on the estimated number of MAIS3+ casualties. (Pérez, K., Weijermars, W., Amoros, E. et al. (2016), Practical guidelines for the registration and monitoring of serious traffic injuries, D7.1 of the H2020 project SafetyCube.) Current CARE data can therefore not be used to give a reasonable annual estimate of the number of serious injuries that can be saved, based on the MAIS3 definition.

4.2 Alternative method to estimate KPI-effects on serious road casualties

When a gross estimate of these potential effects is nevertheless necessary, we need to seek refuge in a simple translation of death data into serious injury data, by applying one or two rules of thumb.

One of those rules of thumb are that there is a reasonably constant ratio between deaths and serious injuries, *for sufficiently specified groups of crashes*. However, the extent to which these groups can be separated and characterized is not known (e.g. whether travel mode and age of the victim are sufficiently determining such groups is actually unlikely; the other travel mode may be relevant, or type of road (speed) etcetera).

E.g. for single vehicle bicycle crashes, the death to serious injury ratio in the Netherlands is approximately 1:40, while for car occupant crashes this ratio is more near 1:2 (see
Table 3.1 for an indication).

	Deaths	MAIS3+	MAIS3+/Death
cyclist without motor vehicle	501	18,992	38
powered two wheelers	1532	9,068	5.9
pedestrian	904	3,373	3.7
cyclist with motor vehicle	1503	5,024	3.3
car occupants <10 years	59	131	2.2
car occupants ≥10 years	4033	8,239	2.0
other	641	819	1.3
Weighted average, excluding bicycles without motor vehicles	8672	26654	3.1

Table 3.1. *Numbers of deaths, MAI3+ injuries and their ratio for the Netherlands, 2000-2009*

The group "other" not only includes trucks and vans, but also vehicles such as buses, agricultural vehicles or (more recently) mobility scooters. Crashes with these types of vehicles are less likely to profit much from most of the KPIs mentioned in this report.

The actual ratio between deaths and serious injuries is different for different Member States, given differences in the number of crashes stratified by age and travel mode.

4.3 Results

We have used the ratios based on data analysis in the Netherlands given in Table 3.1 for these five groups, to estimate a rule of thumb for the reductions in the numbers of serious injuries. It is possible to do this assessment based on the road death data of individual countries. Bearing in mind that the accuracy of this estimate, as well as the use of the above described rule of thumb has limitations, it is not useful to strive for a complex method to slightly improve the accuracy of this assessment regarding the reduction in road injuries.

	KPI	Assumed ratio MAIS3+/Deaths	Road deaths saved	Road injuries saved
1	Seat belts	2.0	905	1849
2	Child restraints	2.2	31	68
3	Helmet (powered two wheelers)	5.9	202	1196
	Helmet (bicycle)	3.0	740	2220
4	Mobile phone use	3.0	1817	5522
5	Impaired driving	3.0	3379	10269
6	Speed	3.0	6489	19720
7	Vehicle safety	2.0	3300	1344
	(with natural decay)	2.0	3295	6590

8	EMS	3.1	2600	7992
9	Infrastructure (Euro RAP assessment)		2029	6083

Table 3.2*. Overview of the results presented in chapter 5. Based on a rule of thumb regarding the ratio between road deaths and serious road injuries, the number of serious injured (MAIS3+) that can be saved based on these KPIs is assessed. Natural decay for vehicle safety regards the decrease due to improved vehicle safety even without further effort to improve this KPI.*

For seat belts, child restraints and helmet use it is clear that the ratios to choose are those for older car occupants, younger car occupants and powered two wheelers.

For vehicle safety, the ratio for older car occupants is used.

For impaired driving, speed and mobile phone use we averaged the ratios for car occupants, pedestrians and cyclists in motor vehicle crashes, assuming that all are equally much involved in alcohol, speed or mobile phone use related crashes. This is a gross estimate. One may argue that car occupants may be present in these crashes more often (which would lower the average), or that powered two wheelers may also be involved in crashes regarding alcohol, speed or mobile phone use (which would increase the average). For EMS, the weighted average for all Dutch crash data (excluding bicycle crashes without a motor vehicle involved) is used.

5 Overlap between safety effects of different KPIs

5.1 Results for all KPIs separately

	KPI	Road deaths saved	Serious Road injuries saved
1	Seat belts	905	1849
2	Child restraints	31	68
3	Helmet (powered two wheelers)	202	1196
	Helmet (bicycle)	740	2220
4	Mobile phone use	1817	5522
5	Impaired driving	3379	10269
6	Speed	6489	19720
7	Vehicle safety	658	1344
	(with natural decay)	3295	6590
	(natural decay)	2637	5246
8	EMS	2600	7992
9	Infrastructure (EuroRAP)	2029	6083

Table 4.3. *Overview of results. Natural decay for vehicle safety regards the decrease due to improved vehicle safety even without further effort to improve this SPI. The effect for infrastructure was suggested by EuroRAP and is not based on our assessment.*

5.2 Results, given that some KPIs target groups may overlap

Some KPIs are complementary and others are likely to have an impact on each other. Hence, the total number of road deaths and serious injuries saved if all KPIs were to end at the target, would not equal the sum of all casualties saved.

This crude sum equals 15038 road deaths and 44753 serious road injuries.

The current number of approximately 25956 road deaths (average of the last three available years in CARE in December 2017, which was 2012-2014, 2013-2015 and 2014-2016, for different sets of countries) is likely to reduce as a consequence of the introduction of safer vehicles, even without further enhancement of the KPI as a consequence of new policies. We estimated that this could reduce the number of deaths by 2641, leaving 23315 road deaths in 2030, without further policies to improve any KPIs.

In case all KPIs mentioned reach a theoretical 100% value, the effects of all KPIs together (including the "natural decay", the reduction of 2641 as a consequence of vehicle safety improvement) would be less than the sum of all KPIs separately. To calculate the overlap between these effects is, in general, a complex task. It involves calculations for all countries separately,

taking into account the target groups of crash victims for each KPI, and the estimated effects in each country.

Instead, we simply ignored all possible correlations. These are both KPIs that improve the safety of completely different groups (e.g. helmet use and child restraints) or KPIs that improve the safety of the same specific group (e.g. seat belts and vehicle safety). Hence, we simply assume the KPIs to be logically independent: as if it is a matter of chance if road death is prevented by each of the improved KPIs. The effects of every KPI are expressed in terms of the proportion of deaths potentially saved. Each KPI leaves a remaining proportion of road deaths that are not saved. The combined effect of all KPIs is taken as 1 minus the product of these remaining proportions. The results are given in Table 5.2.

	KPI	Road deaths (saved)	Serious road injuries saved	calculated value	Formula
1	Seat belts	$S_1 = 905$	$I_1 = 1849$	$P_1 = 0.965$	$P_1 = (T\text{-}S_1)/T$
2	Child restraints	$S_2 = 31$	$I_2 = 68$	$P_2 = 0.999$	$P_2 = (T\text{-}S_2)/T$
3A	Helmet (powered two wheelers	$S_{3A} = 202$	$I_{3A} = 1196$	$P_{3A} = 0.992$	$P_3 = (T\text{-}S_{3A})/T$
3B	Helmet (bicycle	$S_{3B} = 740$	$I_{3B} = 2220$	$P_{3B} = 0.972$	$P_3 = (T\text{-}S_{3A})/T$
4	Mobile phone use	$S_4 = 1817$	$I_4 = 5522$	$P_4 = 0.930$	$P_4 = (T\text{-}S_4)/T$
5	Impaired driving	$S_5 = 3379$	$I_5 = 10269$	$P_5 = 0.870$	$P_5 = (T\text{-}S_5)/T$
6	Speed	$S_6 = 6489$	$I_6 = 19720$	$P_6 = 0.750$	$P_6 = (T\text{-}S_6)/T$
7	Vehicle safety	$S_7 = 3295$	$I_7 = 6590$	$P_7 = 0.873$	$P_7 = (T\text{-}S_7)/T$
8	EMS	$S_8 = 2600$	$I_8 = 8060$	$P_8 = 0.900$	$P_8 = (T\text{-}S_8)/T$
9	Infrastructure (Euro RAP)	$S_9 = 2029$	$I_9 = 6083$	$P_9 = 0.922$	$P_9 = (T\text{-}S_9)/T$
EU remaining proportion					$P = 0.421 = P_1 \cdot P_2 \cdot \ldots \cdot P_9$
EU remaining number		$T_G = 10944$			$T_G = T \cdot P$
Additional values used in the assessment					
EU simple sum deaths saved		$T_{ss} = 21487$			$= S_1 + S_2 + \ldots + S_9$
EU simple sum injuries saved			$I_{ss} = 61581$		$= I_1 + I_2 + \ldots + I_9$
EU current total (average last three years in CARE); road deaths		T=26000			
EU deaths saved by natural decay		$S_{10} = 2644$	$I_{10} = 5246$		
EU total with natural decay (deaths)				$T_{nat} = 23356$	$T_{nat} = T\text{-}S_{10}$
EU with KPI's 100% (deaths saved)				$T_{SPI} = 15056$	$T_{SPI} = T - T_G$
EU deaths saved (KPIs only)				$T_S = 12412$	$T_S = T_{SPI} - S_{10}$
EU injuries saved (including nat. decay)				$I_{SPI} = 43149$	$I_{SPI} = T_{SPI}/T_{ss} \cdot I_{SS}$
EU injuries saved (KPIs only)				37904	$= I_{SPI} - I_{10}$

Table.4. *Calculation of the remaining proportion of road deaths and serious injuries for each KPI, and for all KPIs together*

The expected number of road deaths when all KPI equal 100%, yields 10994, which is 12412 less than the expected number of road deaths without any further policy efforts (23356).

As the actual number of serious road injuries (according to the MAIS3+ definition) is not known, it is not possible to say to what extent a road safety strategy based on optimum KPIs would reduce the number of injuries, but is can be expected that this reduction will be of the same order of magnitude.

When all injuries saved by individual KPIs are added, we find a total of 61581, of which approximately 6590 are saved due to the natural increase of safe vehicles. Assuming the same overlap of SPI's, we find that an extra 37904 seriously injured users can be saved by improving all KPIs to 100%.

Annex 3: EU Road Safety Activity 2015-2017

1. Legislation and inter-institutional work

- Ongoing (adoption planned May 2018): Revision of Road Infrastructure Safety Management Directive and Tunnel Safety Directive (draft impact assessment attached)

- Ongoing (adoption planned May 2018): Revision of the Vehicle General Safety Regulation and the Pedestrian Safety Regulation (draft overview of measures attached); report to EP: http://ec.europa.eu/growth/content/9029-saving-lives-with-safer-cars_en

- Ongoing: Update of legislation on training for professional drivers (CPC)
  - EC proposal https://ec.europa.eu/transport/node/4893
  - Procedure file: http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2017/0015(COD)&l=en
  - Provisional agreement in 2nd trilogue 12 December

- Council Conclusions endorsing the Valletta Declaration: http://data.consilium.europa.eu/doc/document/ST-9994-2017-INIT/en/pdf
  - (see also Recommendations from stakeholders in Valletta: https://ec.europa.eu/transport/road_safety/events-archive/save-date-%E2%80%93-high-level-conference-road-safety-malta-28-29-march-2017_en#valletta)

- Europe on the Move package: https://ec.europa.eu/transport/modes/road/news/2017-05-31-europe-on-the-move_da including proposal on rest times for truck drivers: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017PC0277 and https://ec.europa.eu/transport/sites/transport/files/mobility-factsheet-road-initiatives-rest-time.pdf

- Directive (EU) 2015/413 facilitating cross-border exchange of information on road-safety-related traffic offences
  - Evaluation: https://ec.europa.eu/transport/media/news/road-safety-cross-border-information-exchange_en

- Driving licences: Update for drivers with cardiovascular diseases and diabetes: https://ec.europa.eu/transport/themes/security/news/2016-07-14-driving-licences-commission-updates-rules-drivers-cardiovascular_en

- Regulation concerning type-approval requirements for the deployment of eCall: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2015.123.01.0077.01.ENG

- Background on eCall: https://ec.europa.eu/transport/themes/its/road/action_plan/ecall_en

- Implementing Regulation concerning the technical roadside inspection of commercial vehicles: http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1513003906944&uri=CELEX:32017R2205

- Interim evaluation of the road safety policy framework 2011-2020: https://ec.europa.eu/transport/road_safety/events-archive/interim_eval_report_2011_2020_en

2. Studies

- Ongoing: Study on accident causation for traffic accidents involving powered 2-wheelers and bicycles in the European Union (report due by the end of the year)
  Contract Notice: JO S 126-223447
  Tenders invitation
  Specifications

- Ongoing: Study on the implementation of Directive 2006/126/EC of the European Parliament and of the Council of 20.12.2006 on driving licences (report received, publication in January 2018): https://ec.europa.eu/transport/content/study-implementation-directive-2006126ec-european-parliament-and-council-20122006-driving_it

- Study on Serious Road Traffic Injuries in the EU: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/injuries_study_2016.pdf

- Study on driver training, testing and medical fitness: https://publications.europa.eu/en/publication-detail/-/publication/181c18d0-1e79-11e7-aeb3-01aa75ed71a1/language-en

- ElderSafe - Risks and countermeasures for road traffic of elderly in Europe: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/newspdf/eldersafe_final_report.pdf

- Study on good practices for reducing road safety risks caused by road user distractions: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/newspdf/distraction_study.pdf

- Feasibility study on the Vehicles Information Platform: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/pdf/vehicles/study_vip_2014.pdf

3. Research

- Overview of important research projects: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/nl25_en.pdf

- PROSPECT: https://ec.europa.eu/programmes/horizon2020/en/news/vehicle-safety-systems-better-protect-pedestrians-and-cyclists

4. Other activities

- Commission support for TISPOL's Project EDWARD (2016 and 2017): https://ec.europa.eu/transport/road_safety/second-edition-european-day-without-road-death-edward-day-has-successfully-raised-public-awareness_en

- Excellence in Road Safety Awards:
  2017: https://ec.europa.eu/transport/media/news/2017-06-26-road-safety-awards_en
  2016: https://ec.europa.eu/transport/media/news/2016-05-20-road-safety-awards_en
  2015: https://client.deribaucourt.com/2015-02-04-rsa2015/

- Workshop on best practices for enforcement of road traffic rules: https://ec.europa.eu/transport/road_safety/events-archive/2016_06_03_enf_wsh_en

- Workshop on serious road traffic injuries: https://ec.europa.eu/transport/road_safety/events-archive/2015_11_27_ser_inj_en

- Road safety roundtables: https://ec.europa.eu/transport/road_safety/events-archive/2015_round_tables_en

- Workshop on road user distraction risks: https://ec.europa.eu/transport/road_safety/events-archive/2015_06_03_distraction_en

Annex 4: Summary of Recommendations

Leadership

Recommendations for EU action:

- Adopt a Safe System approach towards zero road deaths and serious injuries.
- Continue to provide road safety leadership at the highest level for Towards Zero.
- Review the Commission's road safety management capacity.
- Consider establishing a European Road Safety Agency as an executive arm.
- Set up a new Commission inter-directorate coordination group in support of the new road safety strategy and its goals, targets and objectives.
- Set up a Safe City challenge and label to encourage leadership and Safe System approaches at local level.
- Engage with the EU's leading employers to encourage new leadership and focus on road death and serious injury prevention.
- Engage with key stakeholders at EU level to encourage contribution to a range of measurable performance objectives, reporting in Annual Results Conferences.
- Create specific road safety funds in support of the measurement of key safety performance indicators, safer roads on the TEN-T and major roads, cross border enforcement and in international development and neighbourhood work in requiring conditionality in funding infrastructure projects, as well as funding of Safe System demonstration projects.
- Make implementing the Safe System approach across the EU the centrepiece of further research under Horizon 2020, the 9th Framework programme (F9) EU and earmarks funds for the next EU-road safety research budget line.
- Provide a periodic status report to the European Parliament on progress in achieving road safety goals, targets and objectives based on key performance indicators.
- Carry out a road safety management capacity to review capacity issues and readiness for action for new shared responsibility for road safety and co-benefits with other societal objectives e.g. occupational health and safety, industry, health, environment, across Commission Directorates (e.g. DG MOVE – several units including road safety (e.g. TEN-T, DG GROW, DG SANCO, OSHA) and with the High-Level Group on Road Safety) and to assist the further development of the strategy to 2030.

Recommendations for national action

- Adopt a Safe System approach towards zero road deaths and serious injuries.
- Ensure capacity in the national lead agency to prove national leadership for road safety goals, targets, objectives and strategy.
- Set up an expert advisory group and national champions to assist in the implementation of a Safe System approach.
- Review arrangements for national agency road safety coordination against good practice.
- Carry out a national road safety management capacity review and engage key agencies and stakeholder who can deliver road safety results.

Long-term goal

Recommendations for EU action:

- Extend the scope of the current long-term goal to include a separate goal for serious injury:
  - By 2050 move close to zero fatalities in road transport
  - By 2050 move close to zero serious injuries in road transport.

Recommendation for national action:

- Adopt a long-term goal towards the ultimate prevention of death and serious injury in road crashes.

Interim targets

Recommendations for EU action:

- Set a new interim target to reduce the number of deaths by 50% by 2030 (2020 baseline).
- Set a new interim target to reduce the number of serious injuries by 50% by 2030 (2020 baseline).

Recommendation for national action:

- Set new interim targets to 2030 to reduce the number of a) deaths and b) serious injuries in road crashes.

Key road safety performance indicators and objectives

Recommendations for EU action:

- Set key EU road safety performance indicators (KPIs) which are directly to the prevention and mitigation of death and serious injury in road crashes.
- Establish common measurement methodologies based on Safety Net Project recommendations and baselines to allow an EU data set and national comparisons.
- Establish a road safety metrics fund to provide incentive and assistance to Member States in collecting KPI data.
- Set up an expert advisory group comprising recognised experts to assist the Commission on strategic and KPI issues.
- Request Member States to collect baseline data for each indicator and to set up a working group within the High-Level Group on Road Safety/CARE expert group.
- Commence work with Member States to establish 2030 measurable KPIs and verifiable KPI targets for EU road safety using the KPIs announced in 2018 (to be announced by December 2019).
- Engage the newly established Commission inter-service coordination body in the adoption of a limited set of 2030 KPI objectives.
- Host Annual Results Conferences post-2020 for agencies and stakeholders to review progress against key performance objectives.

Recommendations for national action:

- Adopt, measure, target, monitor and report progress on a set of KPIs which are directly to the prevention and mitigation of death and serious injury in road crashes.
- Engage in coordinated activity of the HLG, national road safety expert groups and in EU Annual Results Conferences of road safety progress against goals, targets and objectives.
- Set up national Annual Results Conferences to review progress against key performance objectives.

Increasing the safety quality of roads and roadsides

Recommendations for EU action:

- Adopt KPI on the proportion of the comprehensive TEN-T network and other roads of strategic importance with 3-star or better Euro RAP rating.
- Work with Member States to monitor and target progress on this to 2030.
- Support the collection and reporting of traffic volume by mode on all road types.
- Extend the Infrastructure Directive (2008/96) to national main roads and 2) embed elements of a Safe System approach such as mandatory, measurable network-wide safety assessments and minimum performance requirements for certain road infrastructure components to facilitate the smooth roll-out of cooperative, connected and automated mobility.

- Commission an updated Risk Map for the comprehensive TEN-T.
- Encourage knowledge transfer and the adoption of the Safe System approach to road safety engineering on the TEN-T and the secondary network.
- Carry out work to establish a TEN-T road classification which matches speed limits to the road design and layout in line with a Safe System approach.
- Create a Safer Roads Fund or other incentive framework within the Multiannual Financial Framework (MFF) to provide targeted road safety investment on high-risk/high-volume roads on the TEN/T network in line with the Safe System approach.
- Ensure that regional funds for roads are conditional on the use of measurable safety assessment using demonstrably effective tools and identified improvements in infrastructure safety.
- Specifically allocate funds for cycling and pedestrian safety within the Connecting Europe Facility (CEF).
- Promote and fund Safe Corridor and Safe City/Safe *Town* projects on the TEN-T and secondary network comprising road safety engineering and multi-sectoral intervention to achieve results and develop road safety management capacity.

Recommendations for national action:

- Adopt, measure, target, monitor and report progress on KPIs for increasing the safety quality of roads and roadsides on the TEN/T and other roads.
- Adopt a maximum of 30 km/h in residential areas and areas where there are existing or expected high levels of cyclists and pedestrians.

Improving levels of safe travel speeds

Recommendations for EU action:

- Adopt KPIs for improving the level of safe speeds on different road types in the EU
- Agree protocols with Member States on safe speed measurement
- Work with Member States to monitor and target progress on these to 2030.
- Prepare guidance on safe speeds and limits
- Mandate within the revision of the General Safety Regulation voluntary overridable;
- ISA in the first instance, progressing to the non-overridable system on the path to
- full automation.
- Promote and fund speed limit enforcement on the TEN-T and other roads.
- Support Safe Cities demonstration projects with a safe speed element.

Recommendations for national action

- Adopt, measure, target and monitor progress on KPIs for improving the level of safe speeds by road type.
- Review and review speed limits where necessary within national road classifications in line with a Safe System approach.
- Fund a national programme of fixed, mobile and average speed camera enforcement accompanied by supporting awareness campaigns on the adverse consequences of unsafe speeds.
- Nationally fast-track the fitment of voluntary overridable ISA.

Increasing the safety quality of new vehicles

Recommendations for EU action:

- Adopt a KPI on the proportion of new passenger cars with a 5-star Euro NCAP rating.
- Work with Member States and Euro NCAP to monitor and target progress on this to 2030.
- Adopt the proposed package proposed by the Commission for the revision of the General

Safety Regulation and Pedestrian Safety Regulation with special priority and urgency being given to:
- voluntary overridable intelligent speed adaptation in motor vehicles
- automated emergency braking for pedestrians and cyclists
- improvements to frontal and side impact crash protection tests
- improvements to pedestrian crash protection tests
- HGV standards to improve driver vision and vulnerable road user protection
- measures to reduce driver distraction and impairment
- lane keeping assist
- event data recorders

- Amend the EC Directive 2014/24/EU on public procurement to include vehicle safety measures and promote Euro NCAP 5-star vehicles in Commission public procurement of transport services.
- Encourage occupational and tourism sectors to promote take up of Euro NCAP 5-star rated vehicles in health and safety and car rental and leasing activity.
- Invite the High-Level Group on Road Safety to consider national incentives to fast-track proven technologies by a range of means including procurement, safe travel policies, tax and insurance incentives.
- Address the safety needs (design, allowable speeds, use of safety equipment) associated with the use of electric bicycles at speeds higher than 10 km/h.
- Establish a new, harmonised regulatory framework and EU Code of Practice to determine a safe framework for automated driving at EU level.
- Establish a timetable for the introduction of safety-enhancing C-ITS services and what can be achieved to 2030.
- Ensure that Safe Vehicle research is funded in EU research programmes.

Recommendations for national action

- Adopt, measure, target and monitor progress on the KPI on the proportion of new passenger cars in the national fleet with a 5-star Euro NCAP rating.
- Fast-track improvements in vehicle safety and take up of Euro NCAP 5-star rated vehicles
- wherever possible in advance of legislative lead times through in house safe travel policies, public procurement policies and tax and insurance incentives.
- Encourage occupational and tourism sectors to promote take up of Euro NCAP 5-star rated vehicles in health and safety and car rental and leasing activity.

Increasing the efficiency and effectiveness of post-crash care

Recommendations for EU action:

- Set an EU KPI on the proportion of seriously injured road crash victims with access to professional medical assistance within 15 minutes of notification to improve the efficiency and effectiveness of post-crash care.
- Work with Member States to monitor and target progress against it to 2030.
- Commission a study to review the scope of post impact care in reducing the consequences of serious injury in road collisions;
- Monitor and rank annually through EU databases the role of road traffic injury as cause of death and disability compared with other mortality and morbidity.
- Include first responder training in EU provisions for commercial and public transport driver training and emergency services personnel

Recommendations for national action:

- Measure, target and monitor progress on KPIs for improving the efficiency and effectiveness of post-crash care including the proposed EU KPI.
- Review the contribution of improvements to post crash care to reducing deaths and serious

injuries at national level.
- Carry out first responder training for commercial and public transport driver training and emergency services personnel

Increasing levels of safe road use

Cross border enforcement

Recommendations for EU action:
- Review the implementation of the Cross-Border Directive 2015/413 and consider mutual recognition of driver disqualification and further exchange of information on enforcement of key road safety rules.
- Fund high-visibility cross-border enforcement operations organised by the European Traffic Police Network (TISPOL).
- Carry out research on drivers' and riders' perceptions of the risk of being detected for key road safety offences.

Graduated driver licensing

Recommendation for EU action:
- Provide a recommendation on good practice in graduated driver licensing to encourage take up of demonstrably effective practice by Member States.

Recommendation for national action
- Implement graduated driver licensing systems in accordance with good practice to assist young novice drivers manage their exposure to risk in the first years of driving.

Increasing seat belt and child restraint use

Recommendations for EU action:
- Set EU KPIs to increase the use of seat belts and child restraints:
  -Proportion of motor vehicle occupants using a seat belt in a) front seats and b) rear seats
  -Proportion of correct use of child restraints by child occupants
- Work with Member States to monitor and target progress against these to 2030.
- Increase availability and affordability of child restraints, by including them in the category of essential products in EU Directive 77/388/EEC.
- Encourage Member States to introduce lower VAT for child restraints.
- Encourage taxi companies to provide their fleet with child safety restraints.

Recommendations for national action
- Adopt, measure, target, monitor and report progress on KPIs on proportion of the use of seat belts in a) front seats and b) rear seats and the proportion of correct use of child restraints by child occupants.
- Fund combined publicity and enforcement campaigns to encourage compliance with seat belt and child restraint rules.
- Introduce zero-rated Value Added Tax for child restraints.
- Encourage taxi companies to provide their fleet with child safety restraints.

Increasing crash helmet use

Recommendations for EU action:
- Set an EU KPI on the proportions of a) motorcyclists, b) moped users and c) pedal cyclists with correct use of a protective crash helmet.

- Work with Member States to monitor and target progress towards these by 2030.
- Bring forward a recommendation promoting the mandatory use of cyclist' helmets for school-aged children and promote use by cyclists in general.
- Establish a European motorcycle helmet consumer information programme along the lines of the UK SHARP programme.
- Establish a European bicycle helmet consumer information programme.
- Promote zero-rated Value Added Tax for cyclist and motorcyclist helmets.
- Carry out research and development into protective clothing for fatal and serious injury prevention.

Recommendations for national action

- Adopt, measure, target, monitor and report progress on a KPI on proportions of the correct use of protective crash helmets by a) motorcyclists, b) moped users and c) pedal cyclists with correct use of a protective helmet.
- Mandate the use of helmets for riders of all sizes of moped.
- Mandate the use of bicycle helmets for children under 14 years old.
- Fund combined publicity and enforcement to increase usage levels of crash helmets.
- Introduce zero-rated Value Added Tax for cyclist and motorcyclist helmets.
- Provide consumer information to buyers of crash helmets to encourage use of those with the highest safety rating.
- Carry out research and development into protective clothing for fatal and serious injury prevention.

Driving without alcohol or other drugs which impair driving

Recommendations for EU action:

- Establish an EU KPI on the proportion of drivers and riders of motorised vehicles without alcohol or other drugs which impair driving.
- Work with Member States to monitor and target progress towards these by 2030.
- Consider a requirement for alcohol and driving limits of (0.0g/l – 0.2g/l) limits for professional drivers and novice drivers within existing EU regulatory frameworks.
- Produce a recommendation on evidence-based approaches to increase the proportion of driving with drugs that impair driving.
- Consider requiring the fitment of alcolocks in new commercial and passenger transport vehicles within EU Whole Vehicle Type Approval.
- Promote the use of alcohol interlocks for repeat excess alcohol offenders.
- Update the recommendation on alcohol and driving in line with best practice on legal limits; combined high visibility enforcement and publicity and related technology and alcohol offender rehabilitation.

Recommendations for national action

- Adopt, measure, target, monitor and report progress on a KPI on the proportion of drivers and riders of motorised vehicles without alcohol or other drugs which impair driving.
- Review blood alcohol and drug limits and their enforcement against good practice and implement revised legislation where necessary.
- Adopt alcohol interlocks in national offender schemes to address drinking and driving.
- Require the fitment of alcohol interlocks in public procurement of transport services where appropriate.

Driving without distraction

Recommendations for EU action:

- Set a KPI on the proportion of drivers without use of in-car telephones.
- Work with Member States to measure, target and monitor progress on this indicator to 2030.
- Act on promising intervention to emerge from Horizon 2020 research and development.
- Require vehicle manufacturers to demonstrate compliance with the HMI Guidance Statement of Principles on in-vehicle information and other information systems.
- Carry out on-going research into distraction and effective intervention.

Recommendations for national action

- Adopt, measure, target, monitor and report progress on a KPI on the proportion of users driving without use of in-car telephones.
- Fund combined publicity and enforcement of rules on telephone use while driving.
- Carry out research into distraction and effective intervention.

Recommended work for further development of the 2020-2030 strategy

- Project activity to prepare the measurement of new EU key safety performance indicators, measurement protocols and possible targets 2020-2030 (to be announced in 2020) to be agreed by the CARE group reporting to the High-Level Group on Road Safety and the European Commission.
  - Work to prepare definition and guidance for policymaker and practitioners at EU and national levels on the new EU key road safety performance indicators to 2030.
  - Work to specify measurement methods and protocols.
  - Work to prepare baseline measurements for 2020.
  - Work to set targets to 2030 based on established 2020 baselines.

- Project activity to identify specific targeted, cost-effective EU investment in road safety especially in needy areas where there is specific EU competence. This might take place within the new Safer Roads Fund or other financial incentive scheme, if established before 2020 and would include:
  - Updated risk-mapping of the comprehensive TEN-T network.
  - Work to identify and prepare intervention on a series of simple demonstration projects on specific high-volume, high-risk corridors of the comprehensive eastern TEN-T network.
  - Work to identify a carefully structured sample of Star Ratings particularly biased towards the less homogeneous roads and the highest risk roads revealed by Risk Mapping for the comprehensive TEN-T network.
  - Support for development of some simple software as part of the VIDA tool for 'user defined investment plans' to encourage knowledge transfer and self-help for engineers.

- Project activity related to road safety management capacity at EU level. The aim would be to carry out:
  - Work to engage with a range of Commission Directorates to review readiness for action for new shared responsibility for road safety and to establish co-benefits with other societal objectives e.g. transport, health, occupational health and safety, industry, environment. Identify possible new strategic functions for the High-Level Group on Road Safety.
  - Work to define arrangements for the engagement of key stakeholders at EU level in contributing to a range of measurable performance objectives and reporting in Annual Results Conferences on their contributions.

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