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EFFECTIVENESS OF TARGETS FOR ROAD SAFETY

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1 Key Findings

Research Question Key Findings

1.1 Which countries have adopted targets?

- The WHO reported in 2018 that 108 countries had adopted a casualty reduction target.
- Currently 85% of the global population live in countries with a casualty reduction target.

1.2 What is the nature of these targets?

- All of the countries with targets have adopted the total number of fatalities as the measure to be monitored.
- Around half of these countries also adopted additional targets representing sub-groups of fatalities or targets to be achieved mid-way through the period of a strategy.
- Increasingly countries are introducing targets for seriously injured casualties following the widespread agreement of a standard definition of "serious".
- Those countries who monitor safety performance indicators (SPIs) (e.g. Number of speed tickets issued, number of motorcycles with ABS or mean speed per road type etc.) other than just fatalities appear to perform better
- Around one third of these countries set intermediate targets, while only a small number of countries applied SPIs for progress monitoring purposes.

1.3 What evidence is available on the effectiveness of recent targets?

- Whilst the evidence suggest that targets play a role in reducing fatalities, their impact cannot be separated from the wider road safety strategy.
- Countries that have adopted targets are also likely to have adopted a range of related policies and interventions aimed at reducing fatalities. Therefore, it is not possible to say that targets alone have any impact.
- Fatalities are also impacted by wider societal trends.
- Factors including economic growth, increase in travel, police enforcement actions, the numbers of older road users and improvements in vehicle safety standards also had a statistically significant impact on fatality rates in addition to the road safety strategy, either with or without targets.
- Having said that, countries with a target have greater reductions in fatalities than countries without: overall countries with a target experienced a 23% reduction against the 2010 baseline compared to 12% for countries without a target.
- Since 2010, when previous targets were not renewed in the UK, the number of fatalities has increased by 1% according to provisional 2019 fatality data.

1.4 What intermediate actions were implemented as a result of target setting?

- The success of a road safety target is dependent on other policies and interventions that are implemented as part of the wider road safety strategy.
- Institutional data on road safety actions is not consistently available for most countries so the study had to rely on information gathered from road safety experts, which may be subjective and limited.
- Countries respond to the introduction of road safety targets with a wide range of policies and interventions.
- Despite several countries adopting the Safe System approach during the period under review, there were very few that identified institutional level responses to a target.
- Infrastructure improvements were the most frequent response to the adoption of targets.
- Changes to traffic laws and improved safety standards were also reported.

- Thirteen countries reported the adoption of the Safe System approach into the national strategy. Only one country reported improving its post-collision response.
- Around a third of countries routinely monitor fatalities at intermediate points of the road safety strategy period, there is little consistency between countries. Far fewer countries have so far included SPIs amongst the progress indicators and again this is an indication that the Safe System approach has not yet fully been incorporated to national road safety management.

1.5 What targets should be considered for wider roll-out in the UK?

The study recommends that the DfT considers building on the adoption of the Safe System approach to establish a national road safety performance framework, which:

- reconfirms the ultimate goal of the prevention of all deaths and serious injuries
- establishes interim quantitative targets for 2030
- sets a series of intermediate outcome targets, closely aligned to the main policy actions and long-term goal and interim targets, to drive and monitor progress

1.6 What are the key suggested methods for target implementation and delivery?

- The manner in which a safety performance framework is established has a strong impact on the viability of a road safety strategy and the likelihood of achieving the ambitions of policymakers.
- A safety performance framework with final outcome targets and SPIs cannot be separated from the underlying strategy and should be derived from the objectives of the strategy.
- This study has reviewed top-down and bottom-up methods to establish a performance framework and has concluded the most appropriate basis is the analytical approach used in Australia and other countries, which combines both methods to define targets that are aspirational but achievable.
- The study recommends the DfT consider the process comprising the following stages:
    - Aspirational level of casualty reduction established at political level
    - Definition of high priority road safety problems
    - Development of plan for interventions and policies
    - Using best evidence on effectiveness available estimate likely benefits and adjust measures until the expected overall reductions match.
    - Prepare a set off SPIs based on the set of interventions – each major intervention area should have an accompanying SPI
- Political will is essential – the government should strongly endorse the targets and make a firm commitment to realising them.

1.7 What methods should be considered for the long-term monitoring of target impact?

- WHO, OECD and World Bank have all recommended that a range of SPIs should be part of future monitoring processes, alongside final outcome measures.
- This study recommends that DfT consider developing a set of SPIs. These are intermediate outcome measures, which quantify the results of the road safety policies and interventions included in future revisions of the 2019 Road Safety Statement.
- The SPIs should be focussed on British road safety priorities but where relevant should adopt standard definitions to enable international comparability.
- They should be dynamic and adapt to changing road safety priorities.
- The study recommends that SPIs are based on Breen et al (2018) [36] rather than PACTS as these allow international comparison with other countries, refer to speed limits that are based on safe system principles and include a measure relating to cycle safety.
- Whilst the Breen SPIs include a single indicator that relates to vulnerable road users (cyclists), this is unlikely to be sufficient to monitor progress in improving road safety for vulnerable road users and it is recommended that further SPIs are developed that focus on pedestrians, cyclists and other vulnerable user groups.

- Successful monitoring depends on the quality and availability of data. Investment and commitment are required from government to make collation of data mandatory and to provide appropriate resources to carry out the monitoring function.

2 Executive Summary

2.1 Introduction

The United Kingdom (UK) has an enviable road safety track record and has been widely viewed as one of the leading countries internationally. In the decade to 2010 the UK experienced a 43% reduction in fatalities and ranked second after Sweden in mortality rate (deaths per 100,000 population).

Since 2010 progress has been limited, with essentially no change in the UK's total fatalities or mortality rate and the UK has slipped to fifth place in international rankings. The UK is not alone; the rate of improvement has slowed across many countries including the Netherlands, New Zealand, Malta and Australia. In 2010, European Union (EU) Member States agreed a casualty reduction target which aimed to reduce fatalities by 50% by 2020. According to the European Transport Safety Council not one of the EU Member States seems likely to achieve the EU target (although Greece will be close).

However, there are exceptions. Over the same period countries including Norway, Switzerland and Ireland continued to make large gains and demonstrate that much lower traffic mortality rates are readily achievable. Switzerland introduced multiple road safety actions including a reduction in maximum allowable blood alcohol level limit for new and professional drivers (to zero), mandatory use of headlights during the daytime, harsher penalties for excessive speeding and treatment of high-risk sites. Norway adopted a Vision Zero approach, prioritising reductions in head on collisions, single vehicle collisions and collisions involving vulnerable road users, mostly through infrastructure improvements.

In 2015 the UK adopted the Safe System approach to road safety management, as advocated by the United Nations (UN) as part of the 2010 Decade of Action on Road Safety and the 2015 Sustainable Development Goals[11]. The UN recommends that a road safety strategy based on a Safe System approach should include long-term and interim targets for road safety and a system of monitoring and evaluation. In 2018, the World Health Organisation (WHO) reported that 108 countries have set targets for deaths and serious injury and now 85% of the global population live in countries with a road safety target. However, the UK does not currently have any targets for road safety.

In 2019, the Department for Transport's (DfT) Road Safety Statement acknowledged the need to consider whether to adopt a road safety performance framework (targets for road casualty reduction) alongside safety performance indicators in the UK. Safety Performance Indicators (SPIs) or Key Performance Indicators are measurements of the outcomes of policies or other institutional actions which have a quantitative relationship to casualties, e.g. the number of km driven over the speed limit.

In order to do this, DfT committed to review research on road safety performance indicators and targets to establish if there is any evidence to support their effectiveness in road safety improvements. This study delivers on this commitment.

2.2 Approach

This study examined the background to targets within the context of international efforts to improve road safety and the increasingly widespread adoption of the Safe System approach to road safety

management. It reviewed previous research evaluating the effectiveness of casualty reduction targets on road safety in order to provide the most up to date information that will inform the UK future road safety strategy. It reviewed international practice on the application of a safety performance framework and identified the main concepts that are widely accepted as being necessary for a modern road safety strategy.

It focusses on targets relating to number of fatalities as this is the only measure that is consistent across all countries.

The study compiled information published by institutions such as the WHO, Organisation for Economic Cooperation and Development (OECD), World Bank and European Commission to produce a record of international adoption of targets. International and UK collision data was analysed to identify underlying trends and to evaluate the impact of targets on fatal collisions. The study compared the safety performance of four countries that did not set a target as part of the national road safety policy in 2010 (UK, Switzerland, Israel and Canada) with other countries that have set targets and have reliable collision data. Further analysis of UK collision data examined the impact of wider societal factors such as Gross Domestic Product (GDP) and population growth.

The nature of these targets and the response of stakeholders and road safety practitioners was gathered from road safety experts, primarily in EU Member States. It should however be noted that response rates from road safety experts was lower than expected due to work patterns being disrupted by the COVID 19 pandemic. Several intended road safety experts were either in lockdown or had been furloughed by their employer, which influenced survey uptake. Some intended experts also had to prioritise other workplace responsibilities, and thus were unable to find the time required to complete the survey. As a result, the total number of completed survey responses and the numbers of stakeholders who were available for interview were much smaller than anticipated. This limited the conclusions that could be derived from a qualitative analysis of the results.

Finally, this report makes recommendations for the future application of road safety targets within the wider context of a new safety performance framework for the UK.

2.3 Findings

The study addressed seven research questions. The findings for each are given below.

2.3.1 Question1. Which countries have adopted targets?

During the UN Decade of Action (2010 to 2020), what was “best practise” in terms of setting road safety targets has become normal practise. The WHO reported in 2018 that 108 countries had adopted a casualty reduction target. Currently 85% of the global population live in countries with a casualty reduction target.

2.3.2 Question 2. What is the nature of these targets?

The UN recommends that a road safety strategy based on Safe System concepts should include:

- The specification of the long-term goal for road safety
- Interim targets for death and serious injury and for key SPIs
- A monitoring and evaluation system to measure the impact of interventions and policy actions as well as progress towards interim targets.

All of the countries with targets have adopted the total number of fatalities as the measure to be monitored. Around half of these countries also adopted additional targets representing sub-groups of fatalities or targets to be achieved mid-way through the period of a strategy. These can be motivating but do not clearly express the casual relationship between intuitional outcomes and casualty reductions.

Increasingly countries are introducing targets for seriously injured casualties following the widespread agreement of a standard definition of "serious" as level 3 or above on the Abbreviated Injury Scale developed by the Association for Automotive Medicine. Those countries who monitor indicators other than just fatalities (i.e. sub-groups of fatalities, seriously injured and sub-groups of seriously injured) appear to perform better, although the result is not statistically significant.

There are a wide range of approaches to progress monitoring. While around a third of countries routinely monitor fatalities at intermediate points of the road safety strategy period, there is little consistency between countries. Far fewer countries have so far included SPIs amongst the progress indicators and again this is an indication that the Safe System approach has not yet fully been incorporated to national road safety management.

2.3.3 Question 3. What evidence is available on the effectiveness of recent targets?

Whilst the evidence suggest that targets play a role in reducing fatalities, their impact cannot be separated from the wider road safety strategy. It is important to note that countries that have adopted targets are also likely to have adopted a range of related policies and interventions aimed at reducing fatalities. Therefore, it is not possible to say that targets alone have any impact.

This analysis of collision trends shows that countries with a target have greater reductions in fatalities than countries without. There is a considerable variation between countries but overall countries with a target experienced a 23% reduction against the 2010 baseline compared to 12% for countries without a target, although factors other than targets may also have an influence. Before 2010 the performance of the two groups was similar.

Between 1963 and 2010, the UK experienced a steady decline in the numbers of fatalities and seriously injured casualties. Since 2010, when previous targets were not renewed, the number of fatalities has increased by 1% according to provisional 2019 fatality data. This could partly be attributed to growth – during this period the national population has increased by 3.7 million people and traffic has increased. However, the fatality rate per 10^9 km travelled has declined by only 0.5% and the KSI rate has increased by 7%, suggesting there has not been any significant improvement in fatality reduction.

Considering other countries without targets, there is no clear pattern. Canada and Israel have below average performance since 2010. On the other hand, Switzerland shows one of the highest reductions in fatalities since 2010. This again suggests the picture is more complex than just the adoption of a target.

UK's lack of progress since 2010 cannot be explained merely by the steady progress before 2010. Sweden performed better than the UK in terms of road safety performance prior to 2010 but despite this has made much greater progress since.

Fatalities are also impacted by wider societal trends. The study used time series regression models to understand the impact of these factors in comparison with road safety strategy period. This found that factors including economic growth, increase in travel, police enforcement actions, the numbers of older road users and improvements in vehicle safety standards also had a statistically significant impact on fatality rates in addition to the road safety strategy, either with or without targets. Please refer to Annex Two for further details on the analysis.

2.3.4 Question 4. What intermediate actions were implemented as a result of target setting?

The success of a road safety target is dependent on other policies and interventions that are implemented as part of the wider road safety strategy. This study has examined the response of policymakers to targets in two areas – newly introduced interventions and progress monitoring methods. Institutional data on road safety actions is not consistently available for most countries so the study had to rely on information gathered from road safety experts, which may be subjective and limited.

This analysis shows that countries respond to the introduction of road safety targets with a wide range of policies and interventions. Many of the interventions are, of course, intended to reduce casualties while others are intended to improve the road safety management process. Despite several countries adopting the Safe System approach during the period under review, there were very few that identified institutional level responses to a target. Infrastructure improvements were the most frequent response to the adoption of targets. Changes to traffic laws and improved safety standards were also reported. Thirteen (out of 34) countries reported the adoption of the Safe System approach into the national strategy. Only one country reported improving its post-collision response.

There are a wide range of approaches to progress monitoring. While around a third of countries routinely monitor fatalities at intermediate points of the road safety strategy period, there is little consistency between countries. Far fewer countries have so far included SPIs amongst the progress indicators and again this is an indication that the Safe System approach has not yet fully been incorporated to national road safety management.

2.3.5 Question 5. What targets should be considered for wider roll-out in the UK?

The study recommends that the DfT considers building on the adoption of the Safe System approach to establish a national road safety performance framework, which:

- reconfirms the ultimate goal of the prevention of all deaths and serious injuries
- establishes interim quantitative targets for 2030
- sets a series of intermediate outcome targets, closely aligned to the main policy actions and long-term goal and interim targets, to drive and monitor progress

2.3.6 Question 6. What are the key suggested methods for target implementation and delivery?

The experience of many international bodies and other countries has shown that the manner in which a safety performance framework is established has a strong impact on the viability of a road safety strategy and the likelihood of achieving the ambitions of policymakers. A safety performance framework with final outcome targets and SPIs cannot be separated from the underlying strategy and should be derived from the objectives of the strategy.

This study has reviewed top-down and bottom-up methods to establish a performance framework and has concluded the most appropriate basis is the analytical approach used in Australia and other countries, which combines both methods to define targets that are aspirational but achievable. Under this approach, targets are based on political vision, underpinned with interim targets and a concrete implementation and monitoring plan. The study recommends the DfT consider the process comprising the following stages:

- Aspirational level of casualty reduction established at political level
- Definition of high priority road safety problems
- Development of plan for interventions and policies

- Using best evidence on effectiveness available estimate likely benefits and adjust measures until the expected overall reductions match.
- Prepare a set off SPIs based on the set of interventions – each major intervention area should have an accompanying SPI

Political will is essential – the government should strongly endorse the targets and make a firm commitment to realising them.

2.3.7 Question 7. What methods should be considered for the long-term monitoring of target impact?

Bodies including the WHO, OECD and World Bank have all recommended that a range of SPIs should be part of future monitoring processes, alongside final outcome measures.

This study recommends that DfT consider developing a set of SPIs. These are intermediate outcome measures, which quantify the results of the road safety policies and interventions included in future revisions of the 2019 Road Safety Statement. The SPIs should be focussed on British road safety priorities but where relevant should adopt standard definitions to enable international comparability. They should be dynamic and adapt to changing road safety priorities.

This study reviewed the SPIs recommended by the Parliamentary Advisory Council for Transport Safety (PACTS)[38] work already carried out by Highways England and Breen et al's 'Preparatory work for and EU road safety strategy 2020-2030, by Breen et al (2018)[36.] which developed a set of SPIs to form the basis of future monitoring and targets for European countries. The study recommends that SPIs are based on Breen et al (2018) [39] rather than PACTS as these allow international comparison with other countries, refer to speed limits that are based on safe system principles and include a measure relating to cycle safety.

Whilst the Breen SPIs include a single indicator that relates to vulnerable road users (cyclists), this is unlikely to be sufficient to monitor progress in improving road safety for vulnerable road users and it is recommended that further SPIs are developed that focus on pedestrians, cyclists and other vulnerable user groups.

Successful monitoring depends on the quality and availability of data. Investment and commitment are required from across government and more widely to make collation of data mandatory and to provide appropriate resources to carry out the monitoring function.

The study has considered possible sources of existing data for each SPI, and the ease of collecting that date. The findings are shown in Table A.

Table A – Proposed SPIs and possible sources of existing data

	SPI from Breen et al[39]	**Comment on possible data sources and ease of collection**
1	Proportion of traffic volume on the strategic road network and other roads of importance with a 3-star or better Euro RAP rating.	Highways England data NB: HE has a similar SPI
2	Proportion of traffic volume with drivers travelling within the speed limit on urban roads, rural roads, motorways.	DfT Vehicle speed compliance statistics reported annually
3	Proportion of traffic volume on urban, rural, motorways within speed limits which are 'safe and credible'.	Achieved by combining speed compliance data with allocated speed limit data according to safe system specification

	SPI from Breen et al[39]	Comment on possible data sources and ease of collection
4	Proportion of new passenger cars with a 5-star Euro NCAP rating.	Achieved by combining vehicle registration data with public EuroNCAP ratings
5	Proportion of seriously injured road crash victims with access to professional medical assistance within 15 minutes of notification.	NHS ambulance Quality data published monthly, potentially merged with Hospital Episodes data (this requires further cross-government investigation)
6	Proportion of motor vehicle occupants using a seat belt in a) front seats and b) rear seats	Requires representative roadside survey
7	Proportion of correct use of child restraints by child occupants	Requires dedicated representative survey
8	Proportion of a) motorcyclists, b) moped users and c) pedal cyclists with correct use of a protective helmet	Requires representative roadside survey
9	Proportion of drivers and riders of motorised vehicles without alcohol above the legal limit or other drugs which impair driving.	Home Office annual data on breath tests, DfT annual data on alcohol related crashes, data on self-reported drinking and drug driving collected via the Crime Survey for England and Wales.
10	Proportion of drivers not using smartphones or other mobile devices while driving, ideally this will cover any use (both hands free and handheld)	Requires further investigation for the measurement of hands free use specifically but it will likely involve an annual roadside use survey combined with surveys measuring self-reported use, such as that collected via the Crime Survey for England and Wales

3 Introduction

3.1 The UK road safety record

The UK has been amongst the leading countries in road safety for many years. Figure 1[i] shows that there has been a strong decline in the total number of traffic fatalities since a post-war peak in 1966 when there were 7,985 road users who were killed. By 2010 this total had reduced to 1,850 fatalities, a reduction of 77%. More recently in 2019, the European Transport Safety Council (ETSC)[ii] identified that the UK had the fifth lowest accident rate when compared to European countries with a rate of 3.4 deaths per billion km driven. Only Norway, Switzerland, Sweden and Ireland had lower rates by this measure (see Terminology Section 11 on the use of the term “accident”).

Figure 1: Long term trend in traffic fatalities, Great Britain (Stats 19 data)

Despite this, 10 years previously the same indicator[iii] showed the UK had then ranked second and the subsequent improvements made by other high performing countries have not taken place in the UK. Provisional 2019 data from ETSC[2] in Figure 2 indicates that in the period from 2010 – 2019 traffic fatalities reduced in EU Member States by an average of 23.7% whereas the UK was one of only three countries (UK, Netherlands and Malta) where fatalities increased. Other countries with below average fatality reductions included Israel, Cyprus, Germany, Sweden, Hungary, France, Bulgaria, Serbia, Rumania, Denmark, Czech Republic, and Finland. The low levels of progress in OECD countries has been attributed to the increase in cycling, reduced levels of enforcement and increases in distracted driving[iv]. Further factors cited include the aging population, increased travel amongst older road users, the economic impact of the 2008 recession and limitations of other safety measures[v].

It should be noted that wider societal and technological changes have occurred over this ten-year time period. The UK experienced a degree of economic recovery between the years of 2010 and 2019. GDP per head decreased from 2007 to 2010[vi] and in 2010 reached its lowest level since 2003[vii]. Alongside this economic recession, traffic volume in the UK decreased until 2013. GDP steadily increased year on year from 2010 to 2019, and traffic volume also began to increase from 2014 onwards[viii]. These increases in traffic volume from 2014 onwards could potentially be a contributing factor to the stagnation in fatality reduction that the UK has experienced from 2010 to 2019, particularly in the latter half of this time period. In the UK total cycling increased by 13% between 2010 and 2019[ix] but there is no data available that describes changes in enforcement or distracted driving.

United Kingdom population changes have occurred over the time period of 2010 to 2019 that could have an influence on traffic volume and the proportions of vehicle drivers on the UK road network by age. The UK population has grown year-on-year, with long-term international migration as one of the main drivers of the UK population growth[x]. In terms of the age profile of the UK population, like many other European countries, the share of later-life age groups has increased over this same time period. Data from the National Travel Survey also shows that older people are now travelling more[xi] and the proportion of those aged over 70 holding driving licences has increased in recent years[xii].

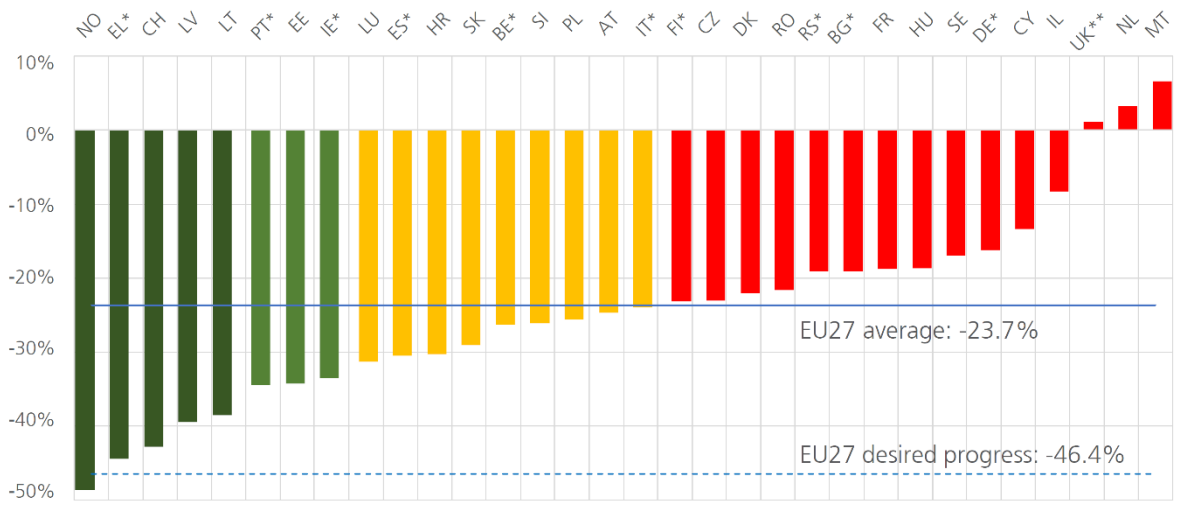

Figure 2: Changes in total fatalities 2010 – 2019, ETSC[2]

*National provisional estimates used for 2019, as final figures for 2019 are not yet available at the time of going to print.
**UK data for 2019 are the provisional total for Great Britain for the year ending June 2019 combined with the total for Northern Ireland for the calendar year 2019 as this was what was available when the analysis was conducted

Country codes: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Cyprus (CY), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Israel (IL), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Romania (RO), Serbia (RS), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), Switzerland (CH), U.K. (GB)

Figure 3 shows ETSC data[1] that compares the changes in mortality in European countries between 2010 and 2020. In 2010 the UK experienced 30 road deaths per million inhabitants and ranked second behind Sweden with 28 per million. By 2019 the rate in the UK had reduced slightly to 29 deaths per million ($29/10^6$) but Norway ($20/10^6$), Sweden ($22/10^6$), Switzerland ($22/10^6$) and Ireland ($29/10^6$) had all improved and the UK ranking had dropped to fifth place although it remained much lower than the EU average of 51 deaths per million. In fact, the UK showed the smallest improvement in mortality since 2010 apart from the Netherlands.

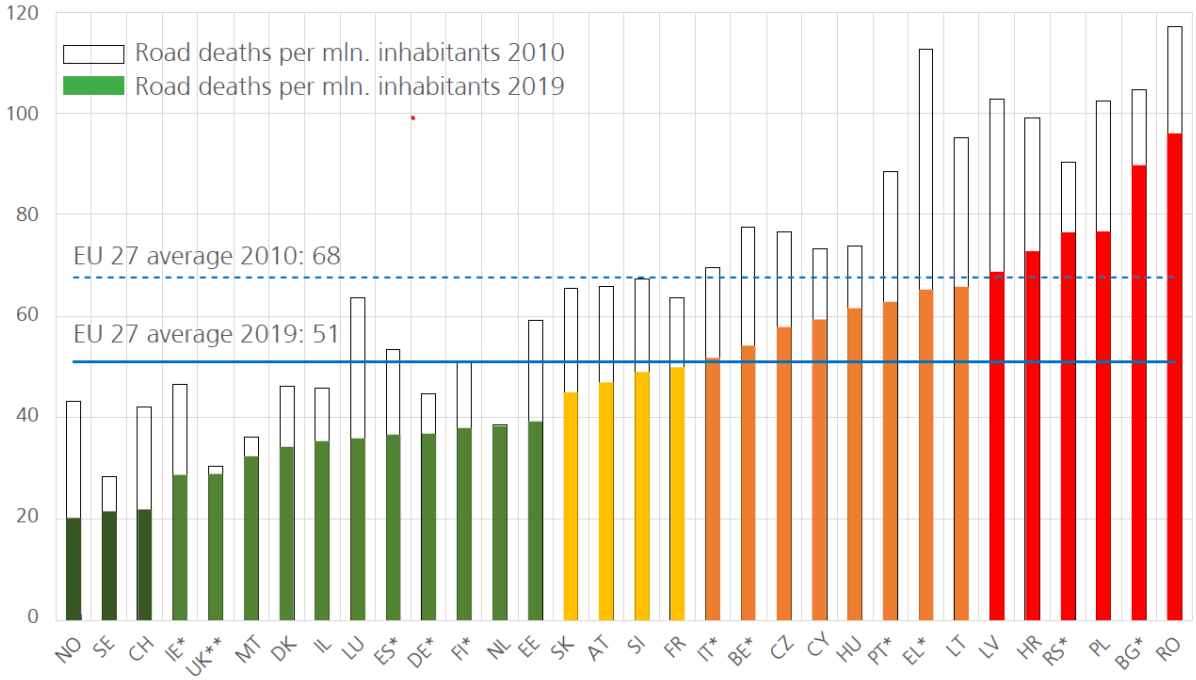

Figure 3: Mortality (road deaths per million inhabitants) in 2019 (with mortality in 2010 for comparison) ETSC[1]

Country codes: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Cyprus (CY), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Israel (IL), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Romania (RO), Serbia (RS), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), Switzerland (CH), U.K. (GB)

*National provisional estimates used for 2019, as final figures for 2019 are not yet available at the time of going to print.

**UK data for 2019 are the provisional total for Great Britain for the year ending June 2019 combined with the total for Northern Ireland for the calendar year 2019 as this was what was available when the analysis was conducted.

Additional societal changes in terms of road travel have occurred over the time period of 2010 to 2019 that may have influenced fatality incidence. New vehicle safety regulations were introduced covering front and side impacts and pedestrian protection which applied to all new cars after 2003 (front and side impacts) and 2004 (pedestrian protection) so that safer vehicles became a progressively larger part of the UK fleet. In parallel the EuroNCAP consumer rating system for vehicle safety has become progressively more demanding with many increased crash prevention and crash protection requirements.

3.2 UK Safe System approach to road safety management

In the 2015 British Road Safety Statement (BRSS) the Government adopted the Safe System Approach for road safety management, as advocated by the UN as part of the 2010 Decade of Action on Road Safety[xiii] and the 2015 Sustainable Development Goals[xiv]. The BRSS outlines five main areas for action

- Safe Roads
- Safe Speeds
- Safe Vehicles
- Safe People
- Post-Crash Care

The Safe System approach highlights the importance of national goals, interim targets, and monitoring procedures as part of a safety performance framework that underpinned a new results-based approach to road safety management. 108 countries globally have adopted targets for traffic casualty reduction[xv] since the UN Agreement, including all current EU Member States, however most are not due to report on progress until after deadlines that are typically 2020 or beyond.

Many other countries, in the EU and elsewhere internationally, that have committed to reductions in those killed or seriously injured on their roads have also established a road safety performance framework to act as a pathway to achieve the ultimate ambition of eradicating death and serious injury. This framework normally includes reduction targets for the whole population of fatalities and often additional targets that refer to children, vulnerable road users or crashes involving a specific risk factor. The aim of these targets is to motivate timely road safety policy actions that allow the target to be met (Allsop[xvi]). National road safety strategies have also started to include targets for seriously injured road users following on from an internationally agreed definition of the 'Serious' category.

Most recently many countries have started to introduce Safety Performance Indicators into the performance framework. These are discussed in detail in Section 3 but broadly provide a measure of the success of interventions and policies, they can be used as a monitoring tool but increasingly may also be targets.

3.3 Fatality targets in Great Britain

There have been five road safety strategies announced for Great Britain since 1980 with the objective of reducing road traffic casualties and fatalities. The main characteristics and interventions of each are summarised in Table 1 below.

The first target was established in 1987 in the publication "Road Safety: the next steps" and applied a 33% reduction in all casualties by 2000 compared with a baseline of the 1981 – 1985 average. By the end of the decade fatal and seriously injured casualties, representing the greatest societal costs, had reduced by 40% and 45% respectively. The following strategy was published in 2000 as "Tomorrow's roads: safer for everyone" and identified three key groups – all killed and seriously injured, children killed and seriously injured and the slight casualty rate per 10^8 vehicle km travelled. Targets were set for each of these groups and by 2010 all.

The UK Coalition Government chose not to set national casualty reduction targets in 2011, and instead focused on enforcement powers and driver education. National casualty reduction targets were replaced with an action and outcomes framework, consisting of measured final outcome indicators and casualty forecasts. The central projected casualty forecast was 1,770 deaths and 18,070 Killed and seriously injured casualties (KSIs) in 2020 (representing a reduction of 37% and 40% respectively on these averages from the time period of 2005 to 2009). If the UK does indeed reach the Strategic Framework 2020 casualty projection, this will be due in part to the large reductions in KSI's in the time period of 2007–10, before the 2011 strategy was published[xvii].

Table 1: Summary of GB road safety targets

Date of publication	Target date	Title	Casualty severity	Baseline	Expected Reduction	Reduction achieved
1987	2000	Road Safety: The Next Steps	• Target - All road traffic casualties	1981 – 1985 ave.	• 33%	• 40% (fatalities) • 45% Serious)
2000	2010	Tomorrow's roads: safer for everyone (2000)	• Target - Killed and seriously injured • Target - Child killed and seriously injured • Target - Collision rate (/10^8 Vehicle Km)	1994 – 1998 ave.	• 40% • 50% • 10%	• 48% • 64% • 42%
2011	2020	Strategic framework for road safety (2011)	• Forecast – All fatalities • Forecast – All Killed and seriously injured	2005 – 2009 ave.	• 37% • 40%	• 35% (2018) • 6% (2018)
2015	-	Working Together to Build a Safer Road System	• No target or forecast	-	-	-
2019	-	A Lifetime of Road Safety	• No target or forecast	-	-	-

Casualty reduction targets were however set for other parts of the Great Britain and for Northern Ireland. The Governments of Northern Ireland, Scotland and Wales set casualty reduction targets relative to the casualty average for 2004–8 and have since adopted the Safe System approach. The UK government did set targets for casualty reduction related to the Strategic Network, which Highways England is responsible for delivering. These are a long-term goal of virtually eliminating road deaths by 2040 on the strategic road network, alongside a target of reducing the number of SRN users killed or seriously injured by 40% by 2020. In the report to Parliament in 2020[xviii] Highways England stated a 30% reduction had already been achieved although further work on casualty reduction is required. Additionally, local authorities in England set their own individual road safety targets. The vision zero strategy has been adopted in London, set by the Mayor of London, TFL and the Metropolitan Police. The goal is to eliminate all deaths and serious injuries on the transport network in London by 2041.

4 Road safety targets within a performance framework

4.1 Safety performance framework

Any consideration of the role of a casualty reduction target has to be conducted in the light of the wider road safety goals and strategies. A broader discussion of the Safe System approach to road safety management and targets and indicators is made in Annex 1. Specifically, targets are a central aspect of a safety performance framework that defines the results focused procedures that comprise a road safety strategy. A safety performance framework has been described as the motivating and coordinating factor that ensures road safety strategies lead to the desired final outcomes. A framework includes:

- The specification of the long-term goal for road safety
- Interim targets for death and serious injury and for key safety performance indicators
- A monitoring and evaluation system to measure the impact of interventions and policy actions as well as progress towards interim targets.

Road safety targets are also widely considered an essential component of an effective road safety management process, as they provide the focus for national road safety management systems and strategies. An OECD report on road safety management (OECD scientific expert group 2000) proposed that 'target setting leads to more realistic and effective programmes, results in more integration of institutional efforts and often produces more focussed allocation of resources by securing political commitment.' These conclusions in the OECD report were primarily derived on the basis of the conclusions of Elvik (1993)[xix] and Elvik (2001)[xx].

Targets are seen as a fundamental aspect of the Safe System approach to road safety management which has been adopted by the EU (European Union), UN (United Nations), WHO (World Health Organisation) and more recently GB. Targets can be catalysts that motivate policymakers and stakeholders to support road safety programs (Wong et al., 2006)[xxi]. Quantified targets are a measure of road safety ambition and are used as a focus for the expected results of the institutional actions promoted by the lead agency in each country. In terms of the jurisdiction over which a target is set, targets set by national governments are more effective than targets set by local or regional levels of government (Elvik, 2001)[17]. Fatality reduction targets should be achievable so that confidence in the road safety management process is preserved but they should also be challenging and push administrations beyond "business as usual".

Targets are a core part of a road safety strategy and have several main functions[xxii]:

- Challenging but achievable targets specify the desired safety performance that has been endorsed by Government. They increase political will and ensure roles are identified as the responsibility of key stakeholder groups.
- Targets and a monitoring framework enable scarce resources to be used most effectively thereby avoiding ineffective interventions and improving road safety performance.
- Previous research has shown that countries with targets perform better than countries without targets. Higher levels of ambition result in better performance.
- Long-term goals and interim targets express Government support to stakeholders and practitioners and strengthens motivation.
- The benefits to countries with a targeted road safety programme including a safety performance framework outweigh the costs involved.

However, a target will not be successful in improving road safety without suitable support and a structured series of policies and interventions that are well implemented. Targets are the result of a road safety strategy, not the primary factor. If targets are too ambitious or do not have sufficient supporting resources, the expected benefits will be quickly lost.

4.2 Target setting

Many targets are expressed as final outcome measures (reductions in deaths, injuries etc.) but, while they can still be motivating, they do not clearly express the causal relationship between institutional outcomes and casualty reductions. They can specify the level of aspiration but do not describe how the reductions will be achieved and the impact of specific road safety interventions may not be discernible. Safety performance indicators, that relate to the implementation of road safety policy actions are one option for this to address this deficiency, as they measure the extent to which promised policy actions are implemented. Examples of such indicators include the number of successful road safety education campaigns, the number of hospitals that have emergency response protocols and number of breath tests per 1,000 population. It should be noted however that an ambitious target can drive decisions about necessary institutional management capacity and the choice and scope of interventions to achieve the target.

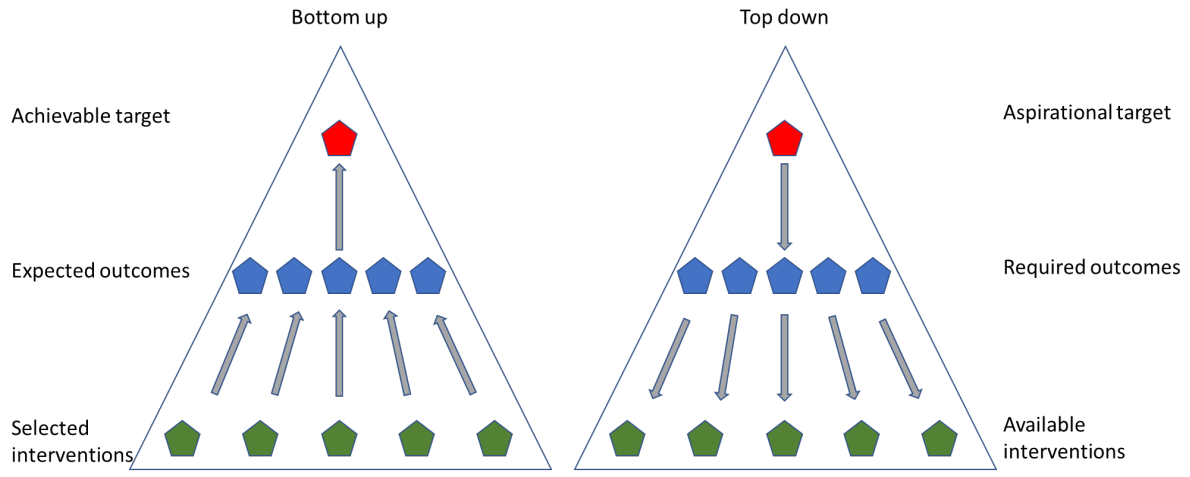

Figure 4: Bottom up and top down target setting

Targets can be specified using a top-down or bottom up approach, shown in Figure 4. Top-down approaches, such as those adopted by the EC (European Commission) and the UN, mostly specify the level of ambition with only a loosely defined programme of interventions. Subsidiarity constraints mean that global or regional bodies may not have the authority to introduce detailed measures

across groups of countries. For example, the current EC target of a 50% reduction was presented and agreed without any detailed analysis of the casualty savings that would derive from specific measures how it might be achieved. It was inevitable that it would be more demanding after the success of the previous target and with no estimation of the most effective policies.

A bottom up target is based on an analysis of the various interventions that could be made and the impact each would have on casualty totals. Politicians set the level of ambition, but specific policies and measures are developed through a detailed estimation of deaths prevented and injuries avoided together and the economic costs of each intervention.

Final outcome measures for killed and seriously injured group represent the greatest societal costs of casualties according to the UN policies. Nevertheless, casualty reduction targets can also be established for specific sub-groups of road users that are of major concern within the Safe System approach.

Targets can address final outcomes – the numbers of people killed or seriously injured – as well as sub-groups. Safety Performance Indicators can also be used targets and are closely connected to the wider strategy. For example, a strategy to reduce alcohol related deaths might adopt a target related to the proportion of drivers that do not drive above the legal limit. By reducing this indicator, it can be expected that that the consequence will be a reduction in the number of deaths.

4.3 Previous research on targets

Three previous key studies have assessed the relationship between fatality reduction targets and actual fatality reductions. These include the studies by Elvik (2001), Wong et al. (2006) and Allsop et al. (2011) who analysed the impact of fatality reduction targets on the annual number of people killed in road accidents. The paper by Allsop et al. (2011) was intended as an update of the paper by Wong et al. (2006). Elvik (2001) and Wong (2006) each examined accident data, gathered between 1981 and 1999 (Wong) and between 1965 and 1999 (Elvik). Alsop reanalysed Wong (2006) using the same data but a different method. The IRTAD data source on road fatalities was consulted during these studies, alongside the Economic Outlook publication by OECD. IRTAD fatality data from the years 1981 to 2000 was analysed in the paper by Wong et al. (2006) and the paper by Allsop et al. (2011).

Elvik (2001) analysed fatality rates (mean annual percentage reduction) over time periods of at least four years, for the time periods both before and after a fatality reduction target was introduced, whereas Wong et al. (2006) and Allsop et al. (2011) performed a similar analysis over three-year periods, using data from 1980-1999. The fatality reduction analysis in these studies was based on a sum of fatality counts in the before period and a sum of the fatality counts in the after period, to produce odds ratios. The nature of the data was time series data. The number of countries that national fatality reduction targets were analysed for across the studies ranged from 9 countries (Wong et al. 2006) to 15 countries (Elvik, 2001).

The before-and-after study by Elvik (2001) was conducted utilising a multivariate regression analysis, with fatality reduction in one 'comparison country' (one without targets) compared to fatality reduction for a 'treatment country' (one with a fatality reduction target). Comparison countries/groups of comparison countries were chosen by Elvik (2001) based on past fatality rate trends and odds ratio calculations. The comparison countries form the basis of the evaluation of the road safety performance of the countries that have set fatality targets. Dummy variables were used to identify countries and to indicate the existence of road safety targets. Wong et al. (2006) also studied changes in fatality counts in treatment countries before and after fatality targets were set. Total variance resulting from the variability of the odds ratio and variability of the observed counts, neither of which can be negative, inform the evaluation of the effectiveness of the targets (Wong et al, 2006). The paper by Allsop et al. (2011) rectified estimates of the short-term effectiveness of quantified road safety targets, and also utilised before and after analysis using comparison groups of countries. The rectification constituted a corrected qualification test for the inclusion of a country in a comparison group.

The authors then presented the numerical effects of this correction on the estimate of the effectiveness of road safety targets. Comparison countries in the different groups were thus altered.

Strong evidence for the effectiveness of target introduction was gained through these studies. Firstly, Elvik (2001) found that a quantifiable road safety target was associated with a small reduction in fatalities over a year on average, with an average improvement of under one percent. The 'distribution skewed slightly towards a reduction in the number of fatalities or accidents.' The difference between treatment and comparison countries over annual percentage changes in fatalities was significant only when the data was aggregated over many countries and over many years (Elvik, 2001). Weighted mean difference in road safety performance was 5.6%, over a mean period of 7.47 years. Secondly, Wong et al. (2006) found that 8 out of 9 countries with a target experienced a drop in road safety fatalities between 1980 and 1999. An average reduction of 17.4% occurred overall across 9 countries when a meta-analysis technique was used. Thirdly, Allsop et al. (2011) rectified the analysis by correcting the qualification test for the inclusion of a country in a comparison group and adjusted the estimation of overall fatality reduction from 17.4% to 10.4%. Though these studies provide us with useful estimates of the effect of targets on fatalities, the fatality data analysed is now out of date by several decades, and a newer fatality data analysis is required.

Allsop (2011) confirms that when analysing the casualty reduction effectiveness of targets the impact of confounding factors cannot be ignored. In a statistical review the impact of an intervention can rarely be distinguished from other measures that are put in place at the same time. Road safety targets are normally a part of a wider casualty reduction strategy potentially comprising a wide range of measures. A statistical analysis at national level is therefore unable to segregate the impact of a target from other aspects of the strategy of which it is a component.

Road safety targets within a performance framework - Summary

The Safe System approach for road safety management has been adopted by the UK in 2015. It identifies the value of a performance framework which would include targets for interventions and policies and also a series of indicators to measure progress towards those targets. The key parts of the framework are:

- The specification of the long-term goal for road safety
- Interim targets for death and serious injury and for key safety performance indicators
- A monitoring and evaluation system to measure the impact of interventions and policy actions as well as progress towards interim targets.

Targets can be set using a top down or a bottom up approach. Top down targets are most commonly used when reasons of subsidiarity preclude bodies having the capability to introduce details interventions. Bottom up approaches are based on the development of a safety strategy where identified measures are each expected to contribute to the total casualty reduction and targets are based on indicators of each of these measures. Previous research has shown that when targets are adopted as part of a longer-term road safety strategy, they are associated with a 10.4% reduction in fatalities over the target period. Many national and global bodies have recommended the adoption of the Safe System approach to road safety management and targets are identified as a central requirement of a Safety Performance framework. Targets are widely understood to represent best practice when implementing a road safety strategy that is based on the Safe System approach and it

is noted a monitoring framework may require additional investment. The main benefits of a target are

1. Challenging but achievable targets specify the desired safety performance expressed by Government. They increase political will and ensure roles are identified as the responsibility of key stakeholder groups.
2. Targets and a monitoring framework enable scarce resources to be used most effectively thereby avoiding ineffective interventions and improving road safety performance.
3. Previous research has shown that countries with targets perform better than countries without targets. Higher levels of ambition result in better performance.
4. Long-term goals and interim targets express Government support to stakeholders and practitioners and strengthens motivation
5. The benefits to countries with a safety performance framework outweigh the costs involved

5 Scope and specific research questions

In the British Road Safety Statement 2019 the Government committed "to conduct a review of research on road safety performance indicators and targets to establish if there is any evidence to support their effectiveness in road safety improvements". In 2020 DfT commissioned WSP and the Transport Safety Research Centre at Loughborough University to conduct this research study to understand the effectiveness of a performance framework in relation to road safety, to include fatality reduction targets and safety performance indicators. In particular, to examine the role targets play in behaviour change and how historic targets and wider factors related to reductions in those killed or serious injured on the roads. From the outset, safety performance indicators (SPI's) will be defined as measures that reflect the operational and safety conditions of the road traffic system, that influence the system's safety performance[xxiii].

The aim of this study is to examine the evidence of the value of road safety targets, within a wider safety performance framework, to future GB road safety strategies. It examines the role of targets as part of broader policymaking, the accompanying actions and outputs that ensure the success of the targets, international experience with previous targets and identifies the most effective method to relate targets to policy actions. In particular it examines the evidence in support of a safety performance framework to bring together levels of ambition and interim casualty reduction targets with effective methods to measure progress.

Seven specific research questions have been identified to be addressed by this study.

5.1 Research question 1: Which countries have adopted targets?

Historic evidence on the impact of targets on road safety is over 20 years old and was conducted when targets were adopted by a smaller number of countries. These conditions may not apply in the current context, so this study has assessed the effectiveness of more recently implemented road safety targets across several countries. Countries that have not adopted targets can serve as a baseline for comparison to countries that have adopted targets in the last decade. It should be noted at the outset that only four countries (Canada, Israel, New Zealand, Switzerland) with reliable casualty data for did not set an overall road safety target. This inherently limits the analyses of the effectiveness of targets that can be made.

5.2 Research question 2: What is the nature of these targets?

To better understand the potential impact of targets and measures used to assess their effectiveness, consideration needs to be given to the nature of the target (i.e. How are targets formulated?)

and the supporting progress monitoring methods. A review of research on road safety performance indicators has been conducted in parallel. The nature of road safety performance indicators has been reviewed as complementary to overall KSI reduction totals.

5.3 Research question 3: What evidence is available on the effectiveness of recent targets?

Accident and fatality incidence data from countries that have implemented road safety targets in recent years has been compared to data from countries that have not set road safety targets in recent years. Furthermore, the study looks at the key factors, including policy indicators, that relate to the numbers of fatalities and the effectiveness of targets and the wider road safety strategy.

5.4 Research question 4: What intermediate actions were implemented as a result of target setting?

The success of a casualty reduction strategy depends, not only on the potential impact of a target, but also on the policies and measures that have been established to achieve the goals and the quality of institutional delivery. This study seeks to establish the nature of the interventions as far as possible and to explore the impact on casualty reduction.

5.5 Research question 5: What targets should be considered for wider roll-out in the UK?

Based on the findings, this study makes recommendations on future road safety targets for GB as part of a wider safety performance framework. It describes the nature of suitable targets but does not specify the values of targets.

5.6 Research question 6: What are the key suggested methods for target implementation and delivery?

To be effective, road safety targets within a wider safety performance framework, must be challenging but achievable with the support of the wider road safety community of stakeholders and practitioners. This study recommends a method with which to achieve this.

5.7 Research question 7: What methods should be considered for the long-term monitoring of target impact?

Progress towards targets is routinely measured annually, irrespective of the nature of the target, and this study makes recommendations on the most suitable approach to provide feedback for future policy actions and interventions.

6 Methodology

Each of the research questions was addressed through data and information gathered in three stages –

1. Review of published information to identify countries with targets and the nature and effectiveness of those targets
2. An analysis of international accident data to compare road safety trends in relation to policies and interventions together with an analysis of UK accident data and indicators related to road safety policies.
3. A web-based questionnaire sent to road safety experts to gather information about policies implemented following new targets supported by targeted interviews with key global experts.
4. Interviews with a small number of road safety experts to capture more detailed descriptions of aspects of road safety strategies.

Table 2 shows the methods that were deployed to address each of the research questions and Figure 5 illustrates the overview of the project and the data collection methods used.

Table 2: Research questions and applied methods

	Method			
	Review of published information	**Accident data analysis**	**Online survey**	**Interviews**
RQ1	X		X	X
RQ2	X		X	X
RQ3		X	X	X
RQ4	X		X	X
RQ5		X	X	X
RQ6	X	X	X	X
RQ7	X	X	X	X

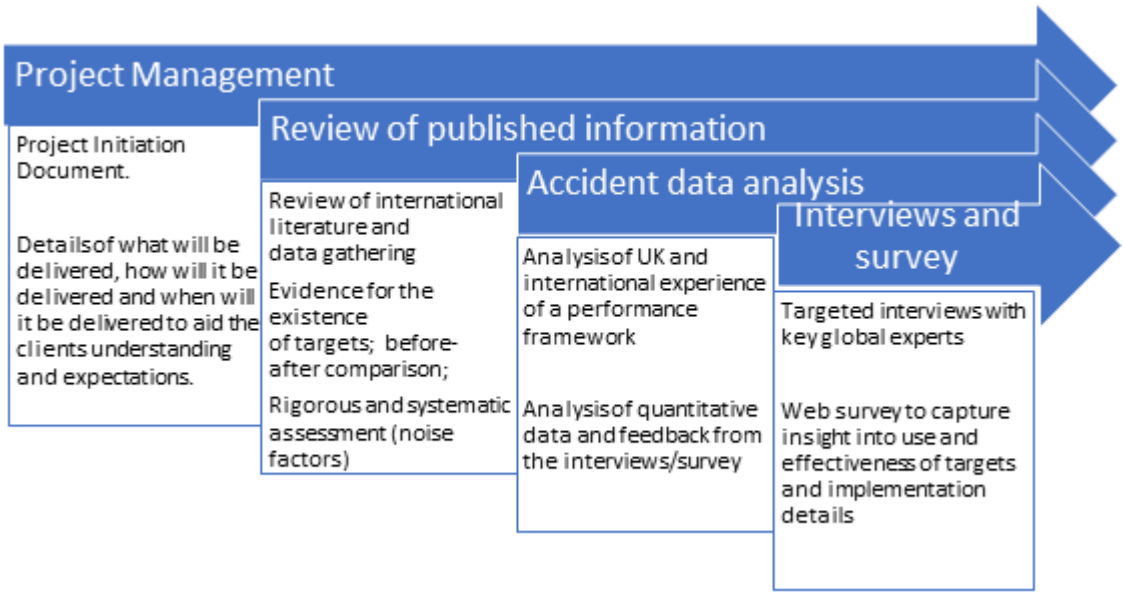

Figure 5: Overview of the project and data collection methods used

6.1 Review of published information

Various aspects of a road safety strategy exist, including overall fatality reduction targets and progress monitoring methods. Publicly accessible reports were consulted to gather information on the following aspects of country road safety strategies listed below in Figure 6:

- Specific fatality reduction target
- Safety performance indicators
- Intermediate targets
- Road safety policy actions

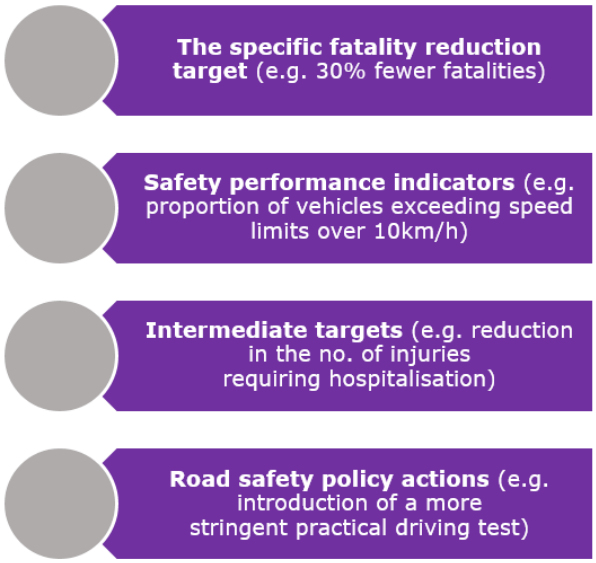

Figure 6: Information gathered in the study

The sourced information from international experiences and best practice guides provided an understanding of target setting and progress monitoring across countries, the accident and mobility data allowed for comparisons in crash trends influenced by policy interventions, and the online surveys and interviews clarified a comprehension of policy responses and practitioner responses to be obtained.

Reports included the annual European Commission Road Safety Country Overview Reports[xxiv], the Road Safety Annual Report 2015[xxv] that is published by the OECD (Organisation for Economic Co-operation and Development) in conjunction with IRTAD and the ITF (International Transport Forum), 14th Annual PIN Report on EU road safety[1], published by the European Transport Safety Council, and the 2018 WHO Global Status Report on Road Safety. It should be noted that more recent editions of some of these reports are available however these were selected to provide information that was relevant to the full period of interest 2010 – 2019.

Data was compiled from the above reports to enable country comparisons to be made. This comprised contrasts between countries across the following aspects: the presence and nature of road safety targets set, the presence and nature of intermediate targets set, baseline dates for target setting, road safety policy actions implemented, and safety performance indicators/outcome measures set. Data was also collected to support subsequent data analysis described below.

6.2 Accident data analysis

Historical records of numbers of traffic fatalities were compiled from public sources. International records were extracted from the EU CARE Accident database[xxvi] and the International Traffic Safety Data and Analysis Group (IRTAD)[xxvii]. The total fatalities for each country were extracted from 2005 to 2019 to enable a statistical analysis to be conducted. This report compares fatality data rather than KSI (killed and seriously injured) data due to discrepancies between countries in how serious and minor injuries have been categorised and recorded. Issues of underreporting of some types of injuries also exist in some countries, which can be avoided with the comparison of fatality data only. The principal limitation of comparing fatality data rather than KSI data is that it disregards serious vehicle accidents that do not involve an actual fatality and in countries with low numbers of fatalities there can be a greater random variation between years.

At the time of this analysis UK accident data was available for the period to 2018 so data for the years 1980 – 2018 was extracted to span the periods when casualty reduction targets existed as well as prior, comparison years. Provisional data for 2019 was available from the European Transport Safety Council derived from the provisional total for Great Britain for the year ending June 2019 combined with the total for Northern Ireland for the calendar year 2019. This data was combined with institutional data derived from publicly available sources which related to wider societal trends as well as policies and interventions. The combined data was modelled using a time-series approach to evaluate the contribution of a range of factors, including road safety strategies, to changes in fatalities. Full details of the methodology and results are shown in Annex 2 – Impact of societal factors and policy interventions on road safety in GB.

6.3 Online survey and targeted interviews

The online survey targeted experts in road safety to understand differences in road safety approaches between countries. The survey gathered information on the nature and impact of road safety targets, and details of road safety management strategies across countries. The research team sent recruitment emails to key delegates from multiple organisations devoted to road safety. These organisations and delegates included collaborators of the IRTAD (International Road Traffic and Accident Database) database of road traffic accidents, colleagues in the OECD and ITF organisations, and members if the ETSC (European Transport Safety Council) organisation. Contacts from IRTAD, OECD, ITF and the ETSC were asked to circulate the recruitment email to partner organisations. Within GB, recruitment emails were sent to members of the PACTS (Parliamentary Advisory Council for Transport Safety) charity and the Road Safety Delivery Group. Requests were made to delegates to forward the recruitment email to any colleagues who had not received the original email.

Response rates of the intended road safety experts was lower than expected, due to employee work pattern disruption. Unfortunately, the questionnaire and the interview stage of the study occurred at the same time as many countries commenced a lock-down in response to the SARS-CoV-2 (COVID 19) pandemic. Several intended road safety experts were either in lockdown or had been furloughed by their employer, which influenced survey uptake. Some intended experts also had to prioritise other workplace responsibilities, and thus were unable to find the time required to complete the survey. The consequence to the study was that the total subjects who completed the questionnaire and the numbers who were available for interview were much smaller than anticipated. This limited the conclusions that could be derived from a qualitative analysis of the results.

The survey collected information on the following topics relating to target setting in their country:

- Specific details on overall and intermediate fatality reduction targets
- Safety performance indicators used in their country, within road safety frameworks
- How realistic the respondent believed these targets to be
- The input of various governing bodies on target setting (e.g. local government, highways regulators)
- Specific information on the magnitude of the effect of road safety policy actions and safety performance indicators on fatality reduction, as perceived by the respondent
- The impact of road safety targets on the motivation of key decision-makers in the country to improve road safety
- Whether political will to increase funding for road safety improvements was maintained for the entirety of the road safety target setting period in their country
- The factors that prompted the adoption of road safety targets

- Whether there has been an evaluation of the effectiveness of targets in their country
- The impact of external factors on the achievement of road safety targets (e.g. economic downturn, extreme weather patterns)
- Their opinions on further adoption of road safety targets in their country

Thirty-two survey respondents representing 18 individual countries completed the survey and provided input from a variety of perspectives. Job titles of the participants included: road safety auditor, research professor, senior research fellow, director of research, road safety advisor, traffic engineer, head of government sector, road safety expert, technical director of transportation, road safety consultant, head of national road safety organisation, head of government department devoted to road safety, research manager, civil servant, principal road safety engineer, and road safety manager. It should be noted from the outset that it cannot be assumed that the road safety experts, though highly knowledgeable about road safety approaches in their country due to the influential job titles held, answered all survey questions about road safety strategies in their country accurately. To minimise the likelihood of false information or data being included in the project analysis, a process of 'fact-checking' was undertaken to compare the data collected in the survey to the data collected during the review of published information. An example of this would be the comparison of the SPI's used in a country reported by the road safety expert to the SPI's used in that same country mentioned in the publicly available document.

Semi-structured interviews were conducted with six of the road safety experts who had completed the survey. The job titles of these interviewees included a research professor in road safety, a traffic engineer working for an NGO, a head of a government department devoted to road safety, a road safety expert, a road safety advisor, and a technical director of transportation. The sample of experts who were interviewed constituted a purposive sample, who all fitted the desired characteristic of being road safety experts with experience of the development or evaluation of road safety targets and/or delivering road safety action plans and interventions. Purposive sampling is used to recruit a sample that holds the desired characteristics of a population, to address the objectives of the study. It is used extensively by qualitative researchers to aid the selection of 'information-rich cases' (Palinkas et al., 2015). The interview sample being of a relatively small size recruited by non-probability sampling is permissible due to the richness of the qualitative data collected (Fusch and Ness, 2015).

The interviews were conducted by telephone by two of the research team members from WSP and Loughborough University, both of whom had extensive experience of qualitative data collection using interviews.

The interviews captured more detailed descriptions of aspects of road safety strategies including:

- Reasons that political will has or has not been maintained
- Barriers to target achievement
- Motivation behind the decision to adopt EU fatality reduction targets
- Contribution of local or regional governments to target achievement
- Expanded explanation of road safety policy actions and safety performance indicators

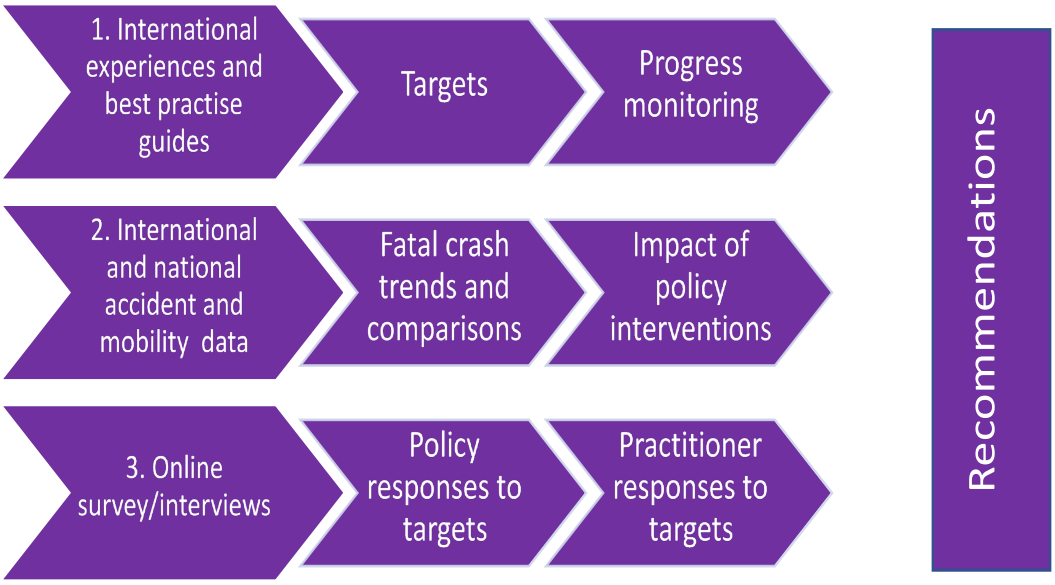

Figure 7: Project dependencies diagram

Figure 7 shows the relationship between the data gathering stages and the formulation of the final recommendations from the project.

7 Study findings

This section presents the findings of the three sections of the study – published literature review, accident data analysis and expert views – compiled and structured to address each of the research questions of the study.

7.1 Which countries have adopted recent targets?

The United Nations established the period 2010-2020 as the Decade of Action for Road Safety and in response countries globally were invited to adopt a target for casualty reduction. The WHO[xxviii] reported in 2018 that 108 countries had adopted a target and while 66 did not. These countries are listed in Table 3 where the WHO has classified the UK as having a target on the basis that Wales, Scotland and Northern Ireland as well as Highways England all have a target. These targets do not apply to the majority of the population or transport in use across the UK so subsequent analysis in this study is based on a definition that a target exists when it applies to the whole country.

All of the G20 countries except Canada and Saudi Arabia had adopted a numerical fatality reduction target by 2018 when the WHO report was published. Many of the countries listed in Table 3 adopted targets over the period until 2018 however the timing of most and the influence on 2020 fatality numbers is unclear. By combining the information in Table 3 with population data it is estimated that 85% of the global population lives in countries with a casualty reduction target.

The low number of countries with comparable accident data and no casualty reduction targets constrains the analysis that can be conducted and the comparisons that can be made. Accident data that is incorporated into the IRTAD database has been shown to be comparable but, although there was data from other countries with no targets, it was concluded the traffic environments were insufficiently similar to the UK for a reliable analysis. The IRTAD database contains details of fatal crashes, although individual countries also record seriously injured casualties there is no standard definition and data is not comparable.

7.1.1 Countries without targets

The following countries did not set a national road fatality reduction target for the complete time period between 2010 and 2020: Canada, Israel, New Zealand, Switzerland. The road safety strategies for these four countries were singled out to be scrutinised by the researchers as reliable road fatality data was available for these countries. A road safety expert (from one of these four countries) that was surveyed, and had experience as a road safety expert as a government employee and as an employee of an NGO, confirmed that an overall fatality target had not been set for the current time period due to the political leanings of the current government. Three of these countries did however implement either fatality outcome measures or safety performance indicators (Canada measured 'Fatalities per billion vehicle km'; Israel measured 'Proportion of drivers wearing seatbelts,' 'Proportion of driver or front seat passengers wearing seat belts,' 'Proportion of rear passengers wearing seatbelts' and 'Child restraint compliance'; Switzerland measured 'Number speed tickets per 1000 population' and 'Percentage of speed offenders per road type). Similarly, all four of these countries implemented multiple road safety policy actions. Canada put in place policy actions across four categories, Israel implemented policy actions across five categories, New Zealand across eight categories and Switzerland across four categories.

Table 3: Countries with fatality reduction targets – WHO classification

Countries with a fatality reduction target								Countries with no fatality reduction target							
1.	Albania	28.	Denmark	55.	Latvia	82.	Portugal	1.	Afghanistan	28.	Israel	55.	Togo		
2.	Argentina	29.	Dominican Republic	56.	Libya	83.	Lao People's Democratic Republic	2.	Angola	29.	Jordan	56.	Tajikistan		
3.	Australia	30.	Ecuador	57.	Lithuania	84.	Qatar	3.	Antigua and Barbuda	30.	Kenya	57.	Timor-Leste		
4.	Austria	31.	Egypt	58.	Luxembourg	85.	Republic of Korea	4.	Armenia	31.	Kuwait	58.	Trinidad and Tobago		
5.	Bangladesh	32.	El Salvador	59.	Madagascar	86.	Republic of Moldova	5.	Azerbaijan	32.	Lebanon	59.	Tunisia		
6.	Belarus	33.	Eritrea	60.	Malawi	87.	Romania	6.	Barbados	33.	Lesotho	60.	Turkmenistan		
7.	Belgium	34.	Estonia	61.	Malaysia	88.	Russian Federation	7.	Benin	34.	Liberia	61.	Ukraine		
8.	Belize	35.	Ethiopia	62.	Mali	89.	Samoa	8.	Brazil	35.	Maldives	62.	Uruguay		
9.	Bhutan	36.	Fiji	63.	Malta	90.	Senegal	9.	Burundi	36.	Micronesia	63.	Uzbekistan		
10.	Bolivia	37.	Finland	64.	Mauritania	91.	Serbia	10.	Cameroon	37.	Mozambique	64.	Vanuatu		
11.	Bosnia and Herzegovina	38.	France	65.	Mauritius	92.	Slovakia	11.	Canada	38.	Nepal	65.	Venezuela		
12.	Botswana	39.	Germany	66.	Mexico	93.	Slovenia	12.	Central African Republic	39.	Niger	66.	West Bank and Gaza Strip		
13.	Bulgaria	40.	Ghana	67.	Mongolia	94.	South Africa	13.	Chile	40.	Pakistan	67.	Zimbabwe		
14.	Burkina Faso	41.	Greece	68.	Montenegro	95.	Spain	14.	Comoros	41.	Papua New Guinea				
15.	Cabo Verde	42.	Guatemala	69.	Morocco	96.	Sri Lanka	15.	Democratic Republic of the Congo	42.	Rwanda				
16.	Cambodia	43.	Guyana	70.	Myanmar	97.	Sudan	16.	Dominica	43.	Saint Lucia				
17.	Chad	44.	Hungary	71.	Namibia	98.	Sweden	17.	Equatorial Guinea	44.	San Marino				
18.	China	45.	India	72.	Netherlands	99.	Thailand	18.	Eswatini	45.	Sao Tome and Principe				
19.	Colombia	46.	Indonesia	73.	New Zealand	100.	The former Yugoslav Republic of Macedonia	19.	Gabon	46.	Saudi Arabia				
20.	Congo	47.	Iran)	74.	Nigeria	101.	Tonga	20.	Gambia	47.	Seychelles				
21.	Cook Islands	48.	Ireland	75.	Norway	102.	Turkey	21.	Georgia	48.	Singapore				
22.	Costa Rica	49.	Italy	76.	Oman	103.	Uganda	22.	Grenada	49.	Solomon Islands				
23.	Côte d'Ivoire	50.	Jamaica	77.	Panama	104.	United Arab Emirates	23.	Guinea	50.	Somalia				
24.	Croatia	51.	Japan	78.	Paraguay	105.	United Kingdom	24.	Guinea-Bissau	51.	South Sudan				
25.	Cuba	52.	Kazakhstan	79.	Peru	106.	United Republic of Tanzania	25.	Honduras	52.	Suriname				
26.	Cyprus	53.	Kiribati	80.	Philippines	107.	United States of America	26.	Iceland	53.	Switzerland				
27.	Czechia	54.	Kyrgyzstan	81.	Poland	108.	Viet Nam	27.	Iraq	54.	Syrian Arab Republic				

7.1.2 Views of road safety experts

The road safety experts who responded to the survey were heavily in favour of the adoption of targets. They considered that a target was a strong motivational driver for stakeholders and practitioners to actively cooperate and commit to improve efforts to reduce road fatalities and casualties. They were also believed to be useful as a tool to measure progress, and to motivate interventions. They also felt targets increased the prominence of road safety strategies at local level, giving support for additional resources, and provide a measure against which they could measure progress. The following quotes from the expert respondents represent the opinions of the experts who were in favour of continued target adoption:

> *"Targets can be an effective way to achieve goals and to provide a reference for progress."*
>
> *"Gives road safety stakeholders a common aim."*
>
> *"To maintain the pressure on policy makers. To show progress. To increase public support."*
>
> *"Because it gives a better effect, is easy to communicate and engages key players. It can show if strategies succeed or fail and can motivate interventions. At the same time is it important that the plan is flexible and can be adjusted regarding the development."*
>
> *"Would force the responsible stakeholders to further actions."*
>
> *"Targets are motivating to decision makers and experts too."*
>
> *"Targets strengthen commitment."*
>
> *"It is a commitment from decision makers, easily evaluated."*
>
> *"I believe target setting is fundamental for proper road safety management."*
>
> *"They are very important for convincing politicians and eliciting motivation of road safety stakeholders."*

The experts referred to the methods used to derive a target with particular reference to top-down aspirational targets including those proposed by bodies such as the UN and EU. Nineteen experts thought that the current fatality reduction target in their country was realistic, whereas eleven disagreed. Two experts were unsure as to whether the target was realistic or not. A target was described as realistic when it was 'based on statistical analysis.'

Various reasons were given as to why targets were not realistic:

> *"They were realistic at the time of setting up the strategy, they are not anymore."*
>
> *"Targets for motorcyclists and older drivers will also be difficult to meet, probably because demographics and trends in the market were not fully considered or understood"*
>
> *"I conducted a policy analysis showing that the target could only be realised by much stronger policy interventions than those currently used and that the target seemed out of reach even with very strong policy interventions."*
>
> *"Targets are not realistic but aspirational."*
>
> *"Expected political support was not obtained."*

One expert passed judgement over the ability of countries across Europe to achieve the agreed upon EU fatality reduction targets:

> *"Not a single country has been able to achieve these targets."*

The experts commented on the long-term nature of targets, typically over 10 years and highlighted the need for continued political will over electoral cycles.

> *"The target won't hold weight if a new political party decides to not continue with the road safety strategy. If the current government is re-elected there will be more pressure on the various agencies to meet the new [percentage] reduction target."*

Countries that have adopted targets? - Summary

The UN Decade of Action on road safety identified that setting a numerical target for casualty reduction as central to road safety management and has prompted many countries to adopt a numerical target for fatality reduction. What was originally "Best Practice" has now become normal practice and, according to the World Health Organisation, 108 countries have established a casualty reduction target. 85% of the global population now live in countries where there is a road safety target. The road safety experts, who responded to the questionnaire, were heavily in favour of national targets on the basis of

- *The expression of political will and commitment to reduce traffic casualties*
- *The increased motivation resulting from a higher level of ambition*
- *The increased level of support from stakeholders and the public*
- *An increased pressure for action and collaboration*

However, the experts also advised there could be negative aspects if

- *The targets were unrealistic or over-ambitious*
- *The targets were set with little analysis of how they would be achieved*
- *The necessary resources were not available*
- *Progress was not maintained over the full period of the road safety strategy*

7.2 What is the nature of these targets?

The way a target is specified has an impact on its achievability. For example, a target of a reduction in accidents per 10^8 km travelled gives little guidance on relevant measures whereas one based on the total speed related crashes is much more directive. There is little consistent guidance about the nature of road safety targets to be adopted by the countries in Table 3 nor how they are to be applied with accompanying policies, interventions and monitoring procedures. Therefore, further details of the targets that have been implemented have been compiled from available sources.

The World Health Organisation[25] provides a brief summary of the targets adopted by many countries and shows information for those countries that have a comparable accident record, defined by inclusion in the IRTAD[24] and CARE[23] accident databases, as a basis for further analysis. The dates of the adoption of targets are not specified but all were established in response to the UN Decade of Action. In the case of EU Member States an over-riding target of a 50% reduction in fatalities was agreed for 2020 but some countries adopted additional targets more closely aligned to the national priorities. It should be noted the reference date for the availability of a target is set in relation to 2010 so some countries, which have introduced targets at a later date may have a different response to the most current data shown in Table 3. Details are shown in Table 4 which describes the primary target together with any formally adopted intermediate targets – targets for specific groups of the

population or types of crashes. The baseline dates shown are the years against which any improvement is to be assessed.

Table 4: Nature of adopted targets for period 2010 – 2020. IRTAD countries

	Does this country have a target or not?	Nature of primary target	Fatality reduction target	Nature of intermediate target (if applicable)	Baseline dates
Argentina	Yes	% reduction target only	-30%	No intermediate target	2016-2026
Australia	Yes	% reduction target only	-30%	No intermediate target	2011 - 2020
Austria	Yes	% reduction target only	-50%	One for serious injuries and one for injury accidents w/ interim targets	2010-2020
Belarus	Yes	% reduction target only	-30%	No intermediate target	2006-2015
Belgium	Yes	% reduction target only	-50%	No intermediate target	2010-2020
Bosnia and Herzegovina (Srpska)	Yes	% reduction target only (population numerical target alongside % reduction target in Srpska)	-30%	No intermediate target	2011-2022
Bulgaria	Yes	% reduction target only	-50%	For serious injuries	2011-2020
Canada	No				
Chile	Yes	% reduction target only	-20%	No intermediate target	2011-2014
Croatia	Yes	% reduction target only	-50%	No intermediate target	2011-2020
Czech Republic	Yes	% reduction target only	-60%	For serious injuries (w/ sub-targets)	2011-2020
Denmark	Yes	Population numerical target alongside % reduction target	-53%, and no more than 120 total fatalities	One for serious injuries and one for minor injuries	2013-2020
Estonia	Yes	Population numerical target alongside % reduction target	-51% and no more than 40 total fatalities	For serious injuries	2015-2025
France	Yes	Population numerical target alongside % reduction target	-50% and less than 2000 total fatalities	No intermediate target	2010-2020
Finland	Yes	Population numerical target	Less than 137 total fatalities	For serious injuries	2012-2020 (or 2025)
Germany	Yes	% reduction target only	-40%	No intermediate target	2011-2020
Greece	Yes	Population numerical target alongside % reduction target	-50% and no more than 640 total fatalities	Does have interim targets for fatalities	2010-2020
Hungary	Yes	% reduction target only	-50%	Does have interim targets for fatalities	2010-2020

	Does this country have a target or not?	Nature of primary target	Fatality reduction target	Nature of intermediate target (if applicable)	Baseline dates
Ireland	Yes	Population numerical target	No more than 124 total fatalities, no more than 25 fatalities per million people	No intermediate target	2011-2020
Israel	No				
Italy	Yes	% reduction target only	-50%	Does have interim targets for fatalities	2010-2020
Latvia	Yes	% reduction target only	-50%	No intermediate target	2014-2020
Lithuania	Yes	% reduction target only	-35% (per million people)	No intermediate target	2011-2017
Luxembourg	Yes	Population numerical target alongside % reduction target	-50% and no more than 16 total fatalities	No intermediate target	2011-2020
Malta	Yes	% reduction target only	-50%	One for serious injuries and one for minor injuries	2014-2024
Netherlands	Yes	Population numerical target	Less than 500 total fatalities	One for injuries requiring hospitalisation (and maintain top four in EU)	2010-2020
New Zealand	Yes	Population numerical target		No intermediate target	
Norway	Yes	Population numerical target	No more than 500 total deaths and serious injuries	No intermediate target	2014-2024
Poland	Yes	% reduction target only	-50%	For serious injuries	2013-2020
Portugal	Yes	Population numerical target alongside % reduction target	-56% and no more than 41 fatalities per million people	No intermediate target	2016-2020
Romania	Yes	% reduction target only	-50%	No intermediate target	2010-2020
Slovakia	Yes	Population numerical target alongside % reduction target	-50% and no more than 172 total fatalities	No intermediate target	2011-2020
Slovenia	Yes	Population numerical target alongside % reduction target	-50% or less than 32 fatalities per million people	For serious injuries	2013-2022

	Does this country have a target or not?	Nature of primary target	Fatality reduction target	Nature of intermediate target (if applicable)	Baseline dates
Spain	Yes	Population numerical target	Less than 37 fatalities per million people	One for serious injuries, one for children without restraint system, one for senior driver fatalities, one for run-over accidents, one for run-off accidents on rural roads, one for work related accidents (during commuting) one for young driver fatalities, one for motorcyclist fatalities, one for motorcyclists seriously injured, one for fatalities in cars in urban areas	2009-2020
Sweden	Yes	Population numerical target alongside % reduction target	-50% and no more than 220 total fatalities	For serious injuries	2007-2020
Switzerland	No				
United Kingdom	No	Varies between country but no national target		No intermediate target	2010-2020
United States	Yes	Population numerical target	Less than 1.02 fatalities per million miles travelled	No intermediate target	2012-2018

7.2.1 Interim fatality targets

Targets are widely identified in best practice guidelines as an essential part of Safe System road safety management in support of the long-term goal of eradicating death and serious injury. In best practice, interim targets, usually over a period of around 10 years, are not seen as ends in themselves but steps towards a long-term goal. Of the 175 countries listed in Table 3, that either did or did not have a road fatality reduction target, 140 were discounted for further analysis of road fatality reduction (including time series analysis) as reliable and complete year on year road fatality data was unavailable. The researchers selected 38 countries for further analysis, including assessment of the nature of the targets (Research Question 2). Reliable fatality data for these countries has been compiled by the IRTAD working group and the OECD. Of these 38 countries, that reliable road fatality data was available for, 34 set targets for road fatality reduction. Figure 8 shows that, of these countries, 18 set a percentage reduction target only, six set a numerical reduction target only, whilst nine set a numerical reduction target alongside a percentage reduction target.

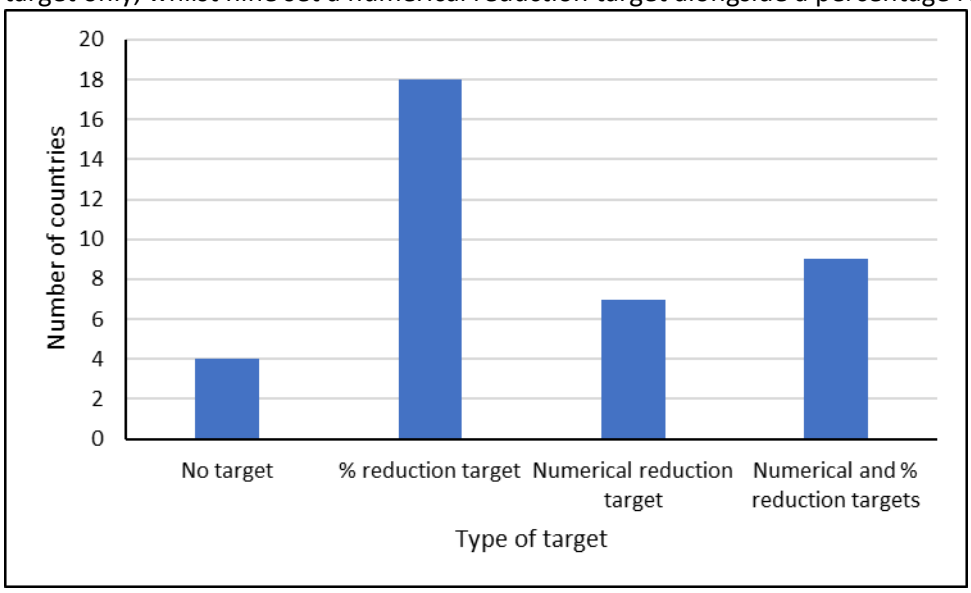

Figure 8: Number of IRTAD Countries with reliable accident data and casualty reduction targets

The setting of overall fatality reduction targets is legislated in various countries (mentioned by two road safety experts). According to accounts of the expert respondents, current road safety strategies had been based off the 'pillars' of the UN Global Plan for the Decade of Action for Road Safety 2011-2020. The pillars include building road safety management capacity; improving the safety of road infrastructure and broader transport networks; further developing the safety of vehicles; enhancing the behaviour of road users; and improving post-crash response (UN, no date). The plan has been used as a guiding document for the road safety strategy. The expert (with experience in an NGO) elaborated on this, explaining that the strategy in their country focussed on the following systematic risk factors: human, vehicle, emergency response and police enforcement. Another expert noted that the Vision Zero approach to road safety had been adopted in their country:

> *"The [strategy] has 10 focus areas: 1. Speeding 2. Alcohol and drugs 3. Inattention 4. Failure to wear seat-belts and helmets 5. Pedestrians 6. Cyclists and moped riders 7. Young drivers up to age 24 8. Accidents with oncoming traffic 9. Single-vehicle accidents 10. Accidents at rural junctions. All of these focus areas are monitored each year regarding: development in accidents, killed, injured, self-reported behaviour (e.g. distraction), observations studies (e.g. helmet use, seat belt use)."*

7.2.2 Intermediate outcome targets

The majority of countries (21 out of 34) that set a road fatality reduction target (of any type) did not set an intermediate target. Of the countries that did set intermediate targets, types included interim targets for fatalities (such as a reduction from 1280 fatalities per year in 2010 to 880 fatalities per year in 2015 – at the midpoint between the baseline dates of 2010 and 2020), sub-targets for number of serious injuries or minor injuries per year, and sub-targets for injuries requiring hospitalisation.

The nature of targets - summary

As well as expressing the level of ambition for road safety, a target can also provide guidance for the most appropriate interventions if it is appropriately specified. The World Bank has identified the following main categories of target

> *1. Final outcome targets – a measure of fatalities or other casualties, normally specified for the period of completion of a road safety strategy*
>
> *2. Intermediate final outcome targets – a measure of fatalities or casualties at points in time before the completion of the strategy*
>
> *3. Safety Performance Indicators (SPIs) or Key Performance Indicators – measurements of the outcomes of policies or other institutional actions which have a quantitative relationship to casualties. An example is the number of km driven over the speed limit.*

This review of the targets that have been established has shown that all countries that have adopted a target have selected the total number of fatalities as the measure to be monitored. Around half of these countries also adopted additional targets representing sub-groups of fatalities or targets to be achieved mid-way through the period of a strategy. Increasingly countries are introducing targets for seriously injured casualties following the widespread agreement of a standard definition of "serious".

7.3 What evidence is available on the effectiveness of recent targets?

7.3.1 International trends

A casualty reduction target was agreed in 2010 by EU Member States with the aim to reduce fatalities by 50% by 2020. The goal was supported by all EU Members although the UK withdrew according to the British Road Safety Statement published the following year. The majority of countries which have published comparable accident data to enable international comparisons are EU member States with some additional members of the OECD. Of the 38 countries with known targets there were 34 countries with sufficient accident data and details of the policy responses to targets available.

The EU Member States had a "top-down" target agreed which was accompanied by a broad strategy but with relatively few specific national or local level interventions since this is the responsibility of EU Member States. Ideally a before and after comparison of fatality trends would be conducted to evaluate the effectiveness of the presence of targets. However, there are several insuperable challenges associated with this and it was not possible to relate changes in fatality totals to targets in a rigorous manner. There are several factors behind this.

- To conduct a full evaluation of targets as an intervention it is necessary to control for confounding factors such previous road safety policies and targets. In fact, most of the candidate countries and all of the EU Member States including the UK had a previous target for the decade to 2010. There were therefore only four countries that could be used as a control group with no national targets either before or after 2010 – UK, Canada, Israel and Switzerland.

- The presence of a casualty reduction target cannot be separated from the policies and actions put in place to achieve the desired outcomes. Therefore, any comparisons should be made on the basis of the full road safety strategy adopted, not only the target.

- The available data derived from published information as well as questionnaires and interviews conducted within this report did not give sufficient detail to enable the nature of interventions to be compared. For example, it might be known that a speed reduction intervention was put in place however there was rarely enough detail to discriminate between small local measures and a national measure.

- The targets in this analysis were set in 2010 but it is not known when precisely the main policies and interventions were put in place so the amount of time available within the decade is not clear

- Some countries such as Germany and the US may have certain aspects of road safety determined at a federal basis, but other aspects may be decided more locally. Only the national targets and indicators are available for analysis

- Previous research has identified national commitment and provision of resources as an essential factor in a successful road safety strategy but there is no systematic data available for the candidate countries to control for this factor.

- There are many prevailing factors such as increases in population, motorisation and GDP that are known to have a fundamental relationship with crashes that underpin the trends over periods of decades. This data is not readily available for most of the candidate countries and therefore analysis opportunities are limited.

According to the European Transport Safety Council[1] not one of the EU Member States seems likely to achieve the EU target although Greece will be close (Figure 2). Outside the EU, Norway and Switzerland have made large improvements and are close to their national targets. Nevertheless, it is helpful to consider the wider context of international trends against which progress can be assessed.

Figure 9 compares the reductions in fatalities amongst the reference countries across the periods 2005 – 2010, 2010-2015 and 2015-2019. During the period 2005 -2010 the average reduction across all countries was 31% and the UK was amongst the best performing with a reduction of 43%. The four countries which now have the lowest mortality rates, Norway, Sweden, Switzerland and Ireland, together achieved a 31% reduction up to 2010. Between 2010, when most countries set a target of a 50% reduction by 2020, and 2015 the average reduction was 15% but the UK only experienced a 5% decrease. Together, Norway, Sweden, Switzerland and Ireland achieved a 22% reduction over the same period. During the final period from 2015 – 2019 fatalities in the UK increased by 7% compared with an average reduction in all countries of 8% and in the four leading countries of 17%.

Together this data indicates that the UK was performing very well before 2010 with reductions in fatalities that were considerably above the average, however, since 2010 further progress has been limited. Although the four countries that now have the lowest mortality rates together only achieved average reductions before 2010, they have all continued with reductions that are considerably above average during both of the following periods. Comparison with Figure 3 shows that these improvements now mean that Ireland has the same death rate per million population as the UK whereas Norway, Sweden and Switzerland are around 30% lower.

It might be suggested that progress has been limited in the UK since 2010 as a result of all feasible or easy casualty reduction opportunities having already been pursued. This analysis does not support that conjecture since comparison of key risk factors shows little change over the decade. For example, 2012 statistics[xxix] show that under free-flow conditions, 48% of cars exceeded the speed limit on motorways and 47% in built up areas (30mph). In 2018[xxx] 46% of cars still were speeding on motorways and 52% on 30 mph roads. Similarly, the most recent data available[xxxi] indicates that the number of fatalities resulting from drink-drive crashes is unchanged from 2010 to 2017 while the numbers of screening breath tests following a collision reduced from 192,826 in 2010 to 44,337 in 2019. Measures to address speed and alcohol related crashes are well established yet the lack of change in speeding and alcohol related crashes indicates the measures may not be deployed in sufficient numbers.

Comparison with other high-performing countries also indicates that further improvement of road safety is possible. In 2010 the UK and Sweden had very similar mortality rates at $30/10^6$ inhabitants and $29/10^6$ respectively yet by 2019 the UK rate had only decreased to $29/10^6$ while Sweden had reduced to $22/10^6$. Over the same period Norway and Switzerland had achieved similar levels to Sweden together suggesting that similar improvements are still possible for the UK.

Norway and Switzerland have both made considerable progress in casualty reduction since 2010. In Switzerland and Norway, road deaths have reduced by 43% and 48% respectively since 2010. It is therefore beneficial to understand the specific road safety strategies that have been implemented.

Switzerland have introduced multiple road safety policy actions that focus on the users of the road network, the infrastructure of the road network, the vehicle fleet and the road safety performance assessment data collected. Four of these influential policy actions were linked to the successful Via Sicura road safety scheme set between 2013 and 2016. These measures in particular were deemed to have strengthened the advances in road safety that were achieved. They included: the reduction in maximum allowable blood alcohol level limit for new and professional drivers (to zero), mandatory use of headlights during the daytime, harsher penalties for excessive speeding and treatment of high-risk sites. Alcohol interlock initiatives were also implemented in Switzerland over the time period of 2010 to 2020. Considering the SPI's that are used for monitoring in Switzerland, the number of speed tickets per 1000 population, the percentage of speed offenders per road type and the mean speed per road type are all measured. Annex 3 shows the complete set of indicators used by Norway, Switzerland as well as other countries reported by ETSC.

Norway have adopted the Vision Zero approach to road safety since 2001. The principles of Vision Zero remain fundamental to the road safety strategy that ran from 2014 to 2024 in Norway: the strategy prioritises reductions in head on crashes, single vehicle crashes, and collisions involving VRU's (vulnerable road users) such as pedestrians and cyclists. The majority of the road safety policy actions that were implemented during this time period related to monetary investments to make the road infrastructure in Norway safer. A program of rumble strips and median barriers installation occurred, and the criteria for securing areas around roads was revised. Additionally, automatic number plate recognition was introduced. The Norwegian Public Roads administration also monitors a set of SPI's and outcome measures and the full details are shown in Annex 3.

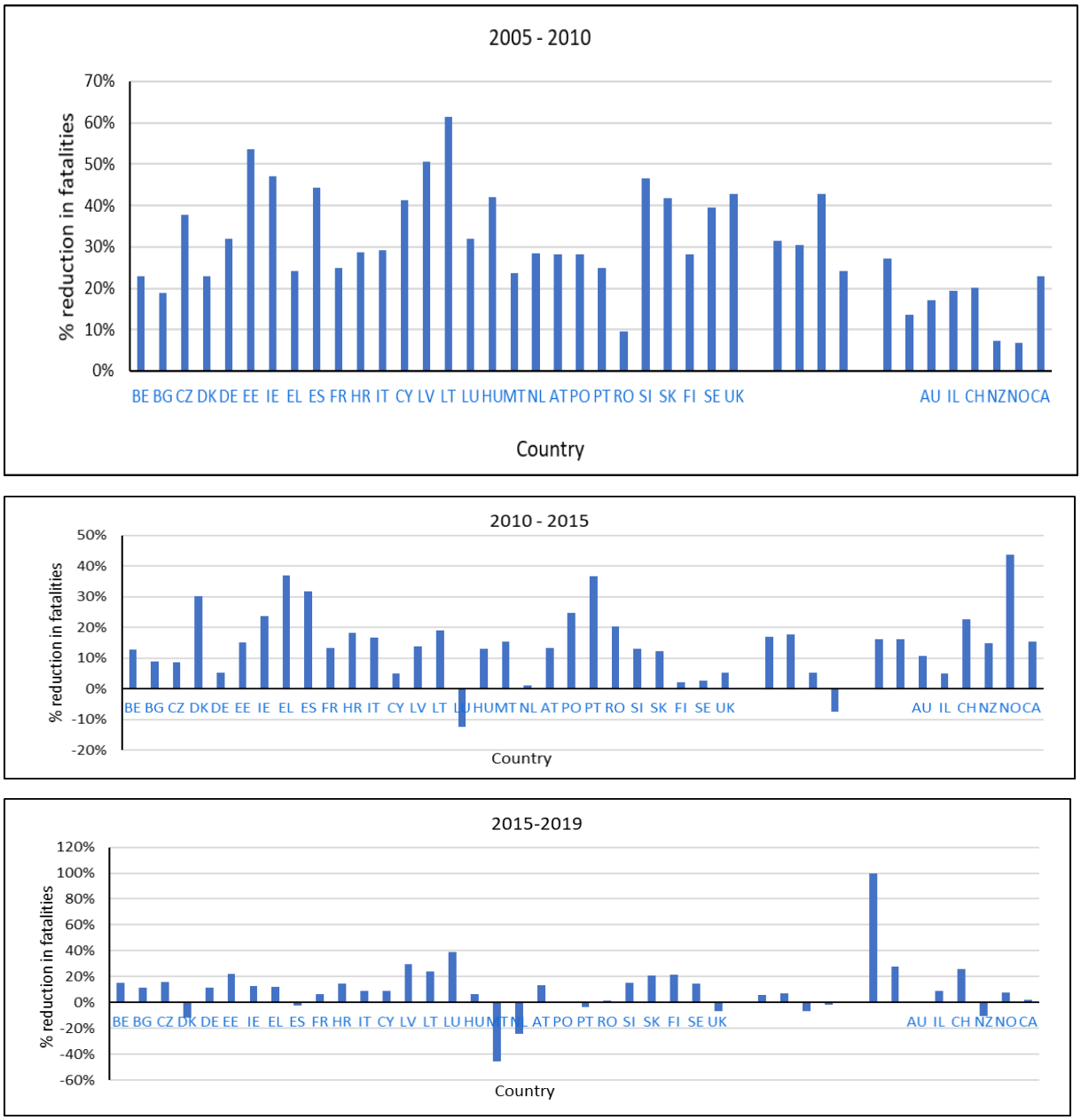

Figure 9: Comparison in fatality reductions -2005-2010, 2010-2015, 2015-2019

Country codes: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Cyprus (CY), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Israel (IL), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Romania (RO), Serbia (RS), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), Switzerland (CH), U.K. (GB)

Figure 10 compares the changes in fatalities before and after the establishment of 2010 fatality reduction targets for the selected group of 33 countries with reliable accident data and available information about the road safety strategy. The axes of the chart lie at the average values for the group – a reduction of 30% before 2010 and of 20% after 2010. Countries in the upper right green quadrant showed above average reductions in fatalities before and after 2010. Spain, Ireland and the Czech Republic are notable members of this group and in some ways comparable to the UK on the basis of population and traffic environment. Countries in the red, lower left quadrant achieved below average improvements in road safety both before and after the 2010 targets and include Australia, New Zealand and the Netherlands. The UK lies in the lower right quadrant and is an outlier with substantially greater reductions in fatalities before 2010 and an increase since then. Comparable countries in the group include Germany and Sweden although both are much closer to the group average. The purple upper left quadrant represents countries that performed below average before 2010 but above average since then. Notable in this group is Norway which had the poorest performance of all countries in the group before 2010 but the best performance since then. The European Transport Safety Council recently stated that the fatality rate in Norway is the best amongst European countries at 20 per million inhabitants compared with the UK at 33 per million[1].

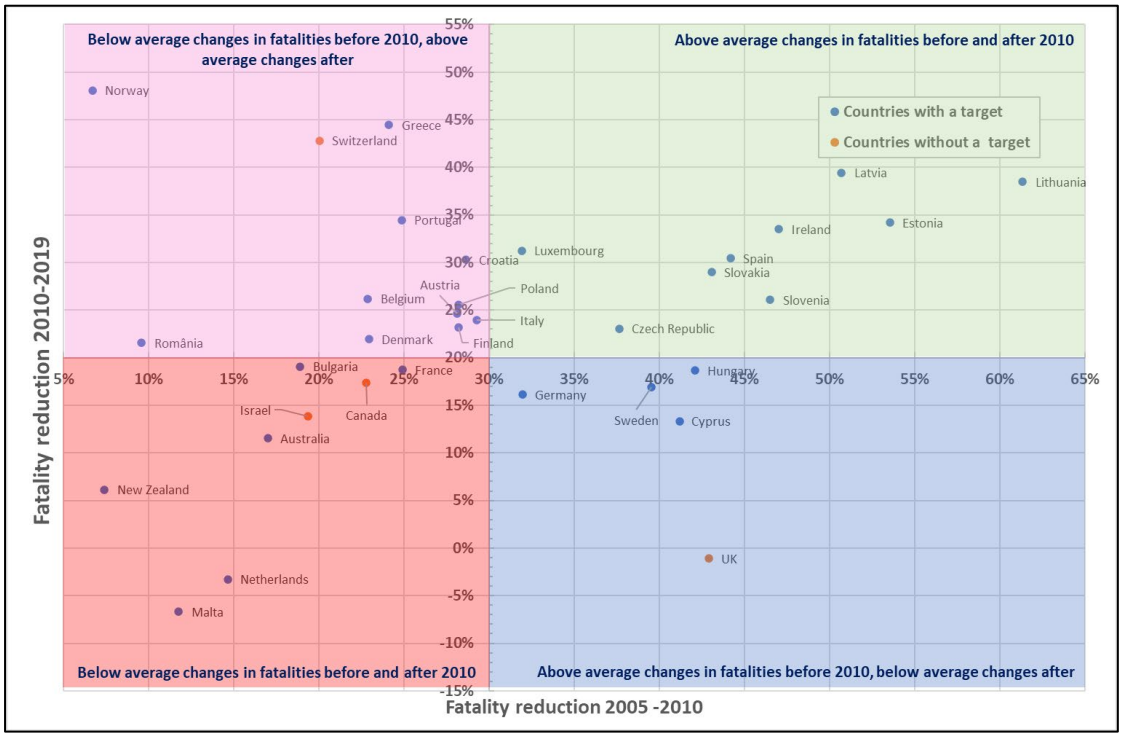

Figure 10: Comparison of changes in fatalities of countries with and without a 2010 target

Figure 10 also shows the four countries in the sample that do not have a 2010 target. There is no clear pattern although it can be observed that three – Canada, Israel and the UK - have below average performance since 2010. In fact, the UK is amongst the poorest performing countries overall joined by the Netherlands. On the other hand, Switzerland also has no post-2010 target yet shows one of the highest reductions in fatalities since 2010.

7.3.2 Impact of targets on road safety outcome measures

To compare the impact of targets on road safety outcomes the reductions in fatalities of countries with a target were compared to those without. When making such comparisons it is important to confirm that the trends of the two groups before the period of interest were comparable so Figure 11 shows the number of fatalities indexed to the 2010 total.

It can be seen that the two groups showed a very similar reduction in fatalities in the period 2005 to 2010 giving confidence that there were no pre-existing factors that could affect subsequent changes. During this period countries with no target set in 2010 experienced a fatality reduction from 42% above the 2010 baseline while countries without a target had a reduction from 47% above. Over the period since 2010, Figure 9, shows that some countries have experienced little or no reductions in fatalities and Figure 11 shows that when the countries with and without a target are compared, those with a target experienced a greater reduction than those without a target.

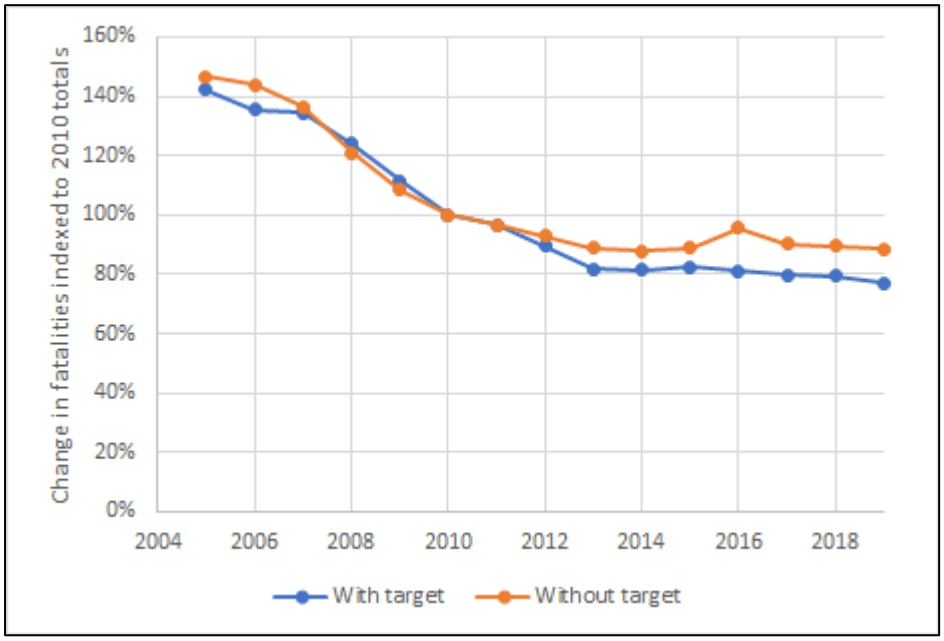

Figure 11: Long-term fatality trends – countries with and without a target (IRTAD data)

This is confirmed by Figure 12 which shows that by 2015 countries with a target had experienced a reduction in fatalities of 18% compared to 11% for countries without a target. By 2019 the reduction for countries with a target had reduced further to 23% while countries without a target showed fatalities still only 12% below the value in 2010.

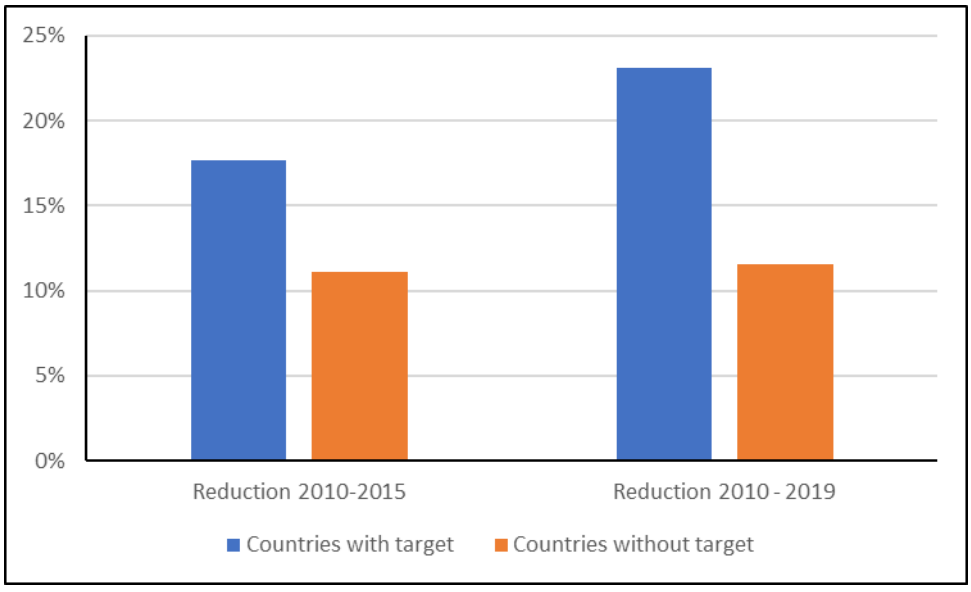

Figure 12: comparison of fatality reduction – countries with and without a target

It should be observed that Figure 12 depicts an association between the presence of a casualty reduction target and a greater reduction in fatalities. It may not represent a causal relationship since the target is one part of a wider road strategy involving many policies, interventions, and other institutional actions. The impact of a target alone cannot be separated from the wider strategy but Figure 12 does indicate that the presence of a target probably is linked to a range of other institutional actions that together have a greater impact on casualties.

7.3.3 Impact of previous Great Britain road safety targets

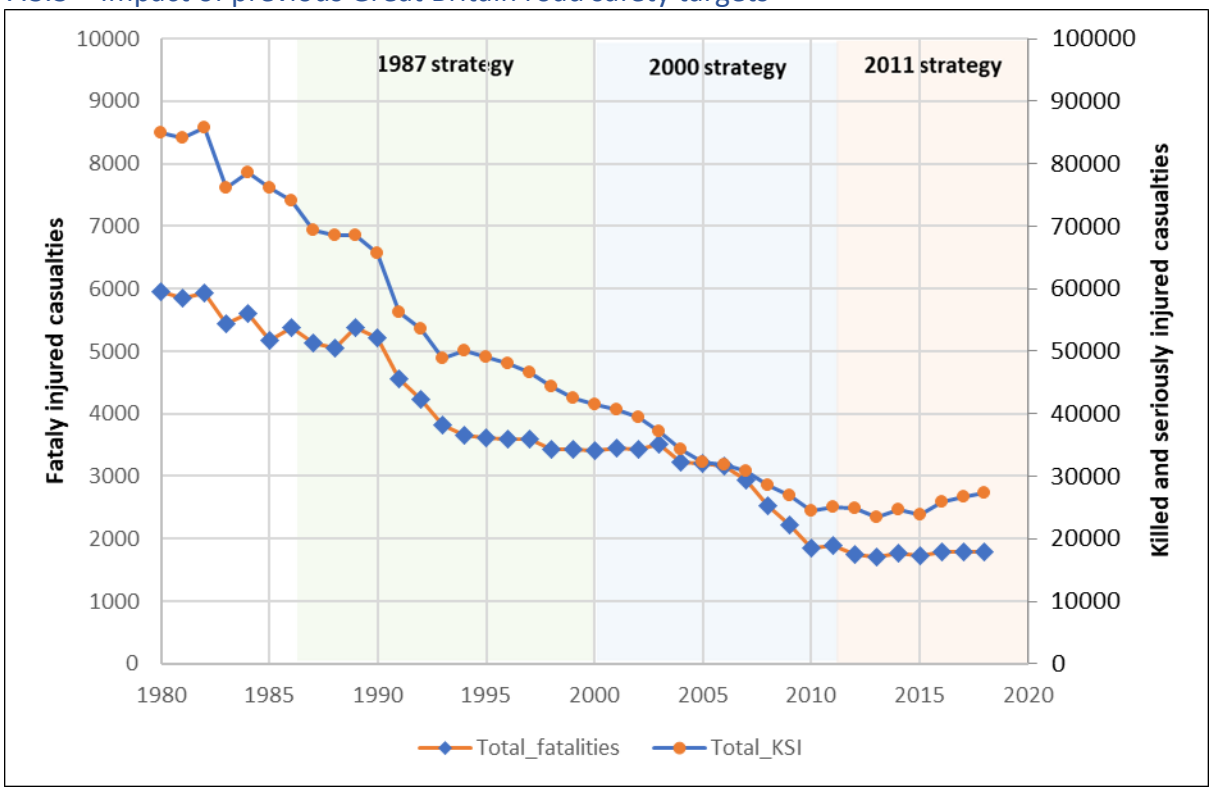

Figure 13: Development of fatal and seriously injured casualties over time - Stats 19 data

The development of fatal and seriously injured casualties over time in the UK is shown in Figure 13 and illustrates the decline in fatalities and seriously injured in the period 1980 to 2018. During this period fatalities declined by 70% from 5,506 in 1980 to 1671 in 2018 while killed and seriously injured casualties reduced by 68% to 24,836. Since 2010 fatalities have reduced by 4% while killed and seriously injured road users have increased by 11%. Preliminary totals for 2019 indicate fatalities are expected to have increased by 1% over the total for 2010.

Both fatal and KSI casualty rates measured in crashes per billion km travelled showed a progressive decline from the pre-1987 baseline until 2010 in line with the pattern of counts of fatalities and KSI casualties. Figure 14 shows that since 2010 fatality rates had declined by 0.5% and KSI casualty rates have increased by 7%.

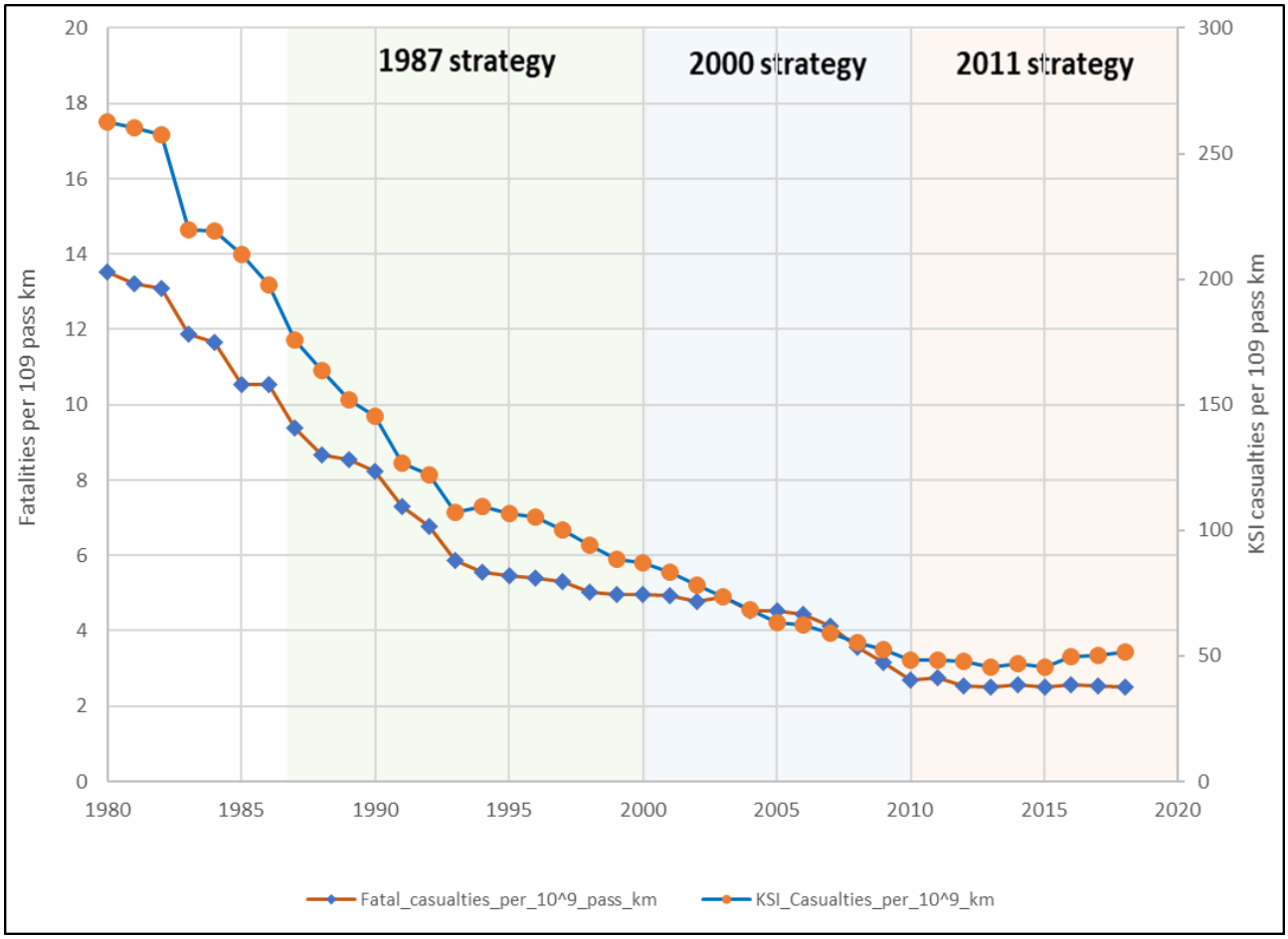

Figure 14: Rate of fatalities and KSI casualties per 10^9 passenger km travelled, UK

The underlying reduction in casualties is a consequence of previous road safety interventions as well as improvements in vehicle technologies, road engineering and traffic management. Changes in modal choice and travel patterns can impact on casualties as will developments in cities. These factors are underpinned by an increasing rejection amongst the public of higher risk behaviours such as drink driving. Alongside these changes in acceptability, 20mph zones are now more widespread. It is within this context that the impact of casualty reduction targets is to be examined.

Targets are considered to be an enabling step, smoothing the pathway to a structured set of interventions and investments in road safety, however the main impact of targets alone is not readily quantifiable and there is little available data on the direct outcomes listed above. Therefore, the impact of targets on the safety management process cannot be separated from that of the wider road safety strategy.

Figure 15 and Figure 16 show the progression of fatalities and KSI casualties following the introduction of successive road safety strategies. The period of each strategy is labelled in elapsed years with the start of each period labelled as year 1. The periods had varying length with the shortest being the seven-year baseline from 1980 to 1986 and the longest being the 13 year strategy from 1987. The charts also show the linear regression of the trend over each of the periods, in this equation y is the number of fatalities or KSI casualties and x is the number of years since the start of the strategy. The R^2 value represents the goodness of fit of the regression.

It should be noted that over each of the periods between 1980 and 2010 both fatalities and KSI casualties show a consistent reducing trend while the trend over the most recent period of road safety strategy is either unchanging or increasing for the two groups.

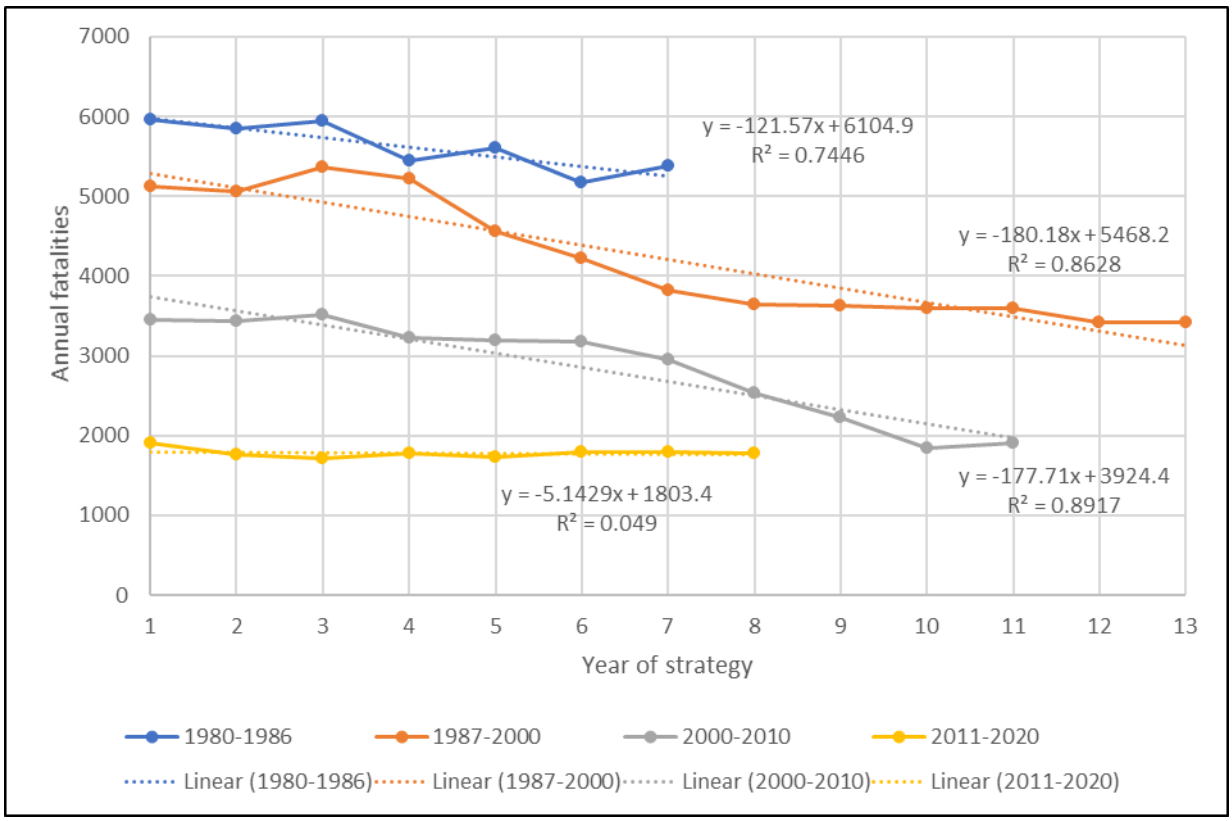

Figure 15: Development in fatalities for successive periods of road safety strategy

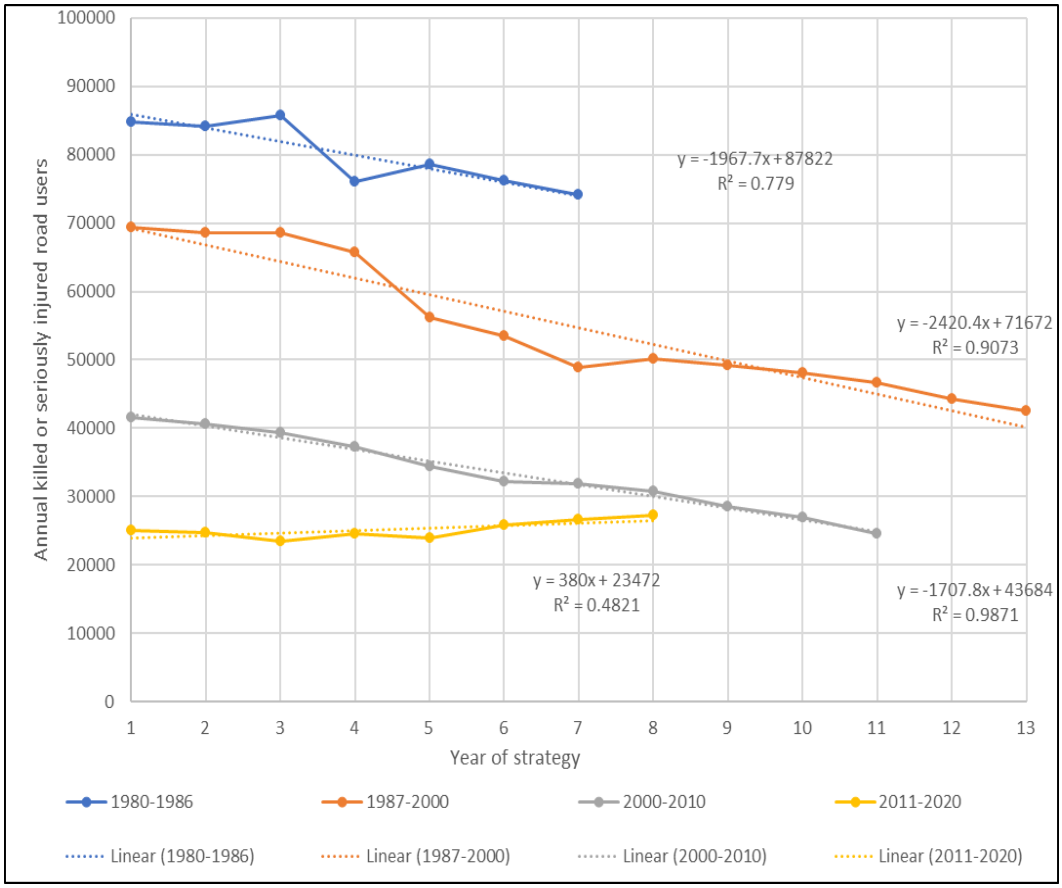

Figure 16: Development in KSI casualties for successive periods of road safety strategy

Table 5: Summary of average reduction in fatalities and KSI casualties

Date range	Primary target	Average reduction in fatalities per year	Average reduction in KSI per year
1980 – 1986	No target	122	1968
1987 – 2000	30% reduction by 2000, all crashes	180	2420
2001 – 2010	40% KSI reduction	178	1708
2011 – 2020	No target	5	-380 (increase)

The reduction in fatalities and KSI casualties is summarised in Table 5. Before the introduction of the 1987 strategy fatalities were reducing by an average of 122 per year and KSI casualties by 1986 per year. Alongside the introduction of the strategy with the target the reduction in fatalities increased to 180 per year and KSI casualties to 2420 per year. During the third phase, when the primary target was a 40% reduction in KSI casualties, fatalities reduced by an average of 178 per year, still above the baseline rate from 1980 – 1986. With no target set for the years 2011 – 2020 there was no visible reduction in fatalities (R^2 = 0.049) while KSI casualties increased by an average of 380 per year. The low value of R^2 indicates that there was no relationship between the presence of the strategy and the numbers of fatalities.

During the period of each road safety strategy other factors in addition to the road safety strategy may have been influential on the change in fatalities. Such factors include economic growth, increase in travel, police enforcement actions, vehicle safety, the elderly population and other factors.

To understand the impact of these factors in comparison with each road safety strategy time series regression models have been developed. Full details are shown in Annex 1 and the results are presented in Table 6 below. The table shows the impact of each strategy, regardless of statistical significance, together with factors found to be significant at the 5% level (0.05 or below).

Table 6: Summary of factors in time series regression model of fatality rate (fatalities per 10^9km travelled)

Period	Factors	Significance	Impact on fatalities
1987 - 1999	Strategy 1987-1999	0.101	Decreasing
	% of population aged 65+	0.001*	Decreasing
	Central Gov expenditure on transport	0.012*	Increasing
	Total number of Police officers	0.000*	Decreasing
	% of car population produced after 1996	0.000*	Decreasing
	Total annual vehicle registrations	0.002*	Increasing
2000 - 2010	Strategy 2000 - 2010	0.510	Increasing
	GDP per capita	0.000*	Decreasing
	% of car population produced after 1996	0.006*	Increasing
	Total annual vehicle registrations	0.015*	Increasing
2011 – 2018	Strategy 2011 - 2018	0.001*	Increasing
	% of population aged 65+	0.000*	Decreasing
	GDP per capita	0.048*	Increasing
	Total annual vehicle registrations	0.049*	Increasing
	Total number of Police officers	0.000*	Decreasing

- significant at 95% confidence interval (* = significant)

These results indicate that the impact of each safety strategy has to be considered alongside the potential effect of other societal factors. In practice it is difficult to specify statistically what a "safety strategy" is since the label represents the complete set of national and local policies, interventions actions and other measures that have been put in place. The manner in which interventions are put in place may vary across the country and are dependent on funding and commitment. The results generally can be taken as an indication that a more detailed analysis with more specific data is needed to fully understand the impact of societal level factors.

Impact of targets - summary

This analysis of international and national accident trends has shown that countries that have a target have greater reductions in fatalities than countries without. There is a considerable variation between countries but overall countries with a target experienced a 23% reduction against the 2010 baseline compared to 12% for countries without a target. Before 2010 the performance of the two groups was similar. It is likely that countries that adopt a target also adopt a range of related policies and interventions that provide an increased effectiveness in fatality reduction. This result is closely in line with previous estimates of the effectiveness of targets in reducing fatalities. The performance of

the UK in road safety over the period since 1980 has been related to the successive road safety strategies. The period of the first two strategies with a target, from 1987 to 1999 and 2000 to 2010, was associated with substantial reductions in fatalities, although it should be considered that the years following the 2008 financial crisis would have been affected by changes in mobility. The period from 2011 to 2018, when the road safety strategy did not include national target, was associated with a small increase in fatalities. Over the period from 2010 to 2019 the UK did not perform well compared with other countries. By 2019 fatalities had increased by 1% above the 2010 levels according to provisional figures while all remaining countries in the group, regardless of adoption of a target, showed a 23% decrease. During this time, the UK population increased by 3.7 million and potentially this would be an increasing factor on fatality total numbers. However, this analysis has shown that UK fatality rates, which control for increased exposure, have decreased by only 0.5% since 2010 and KSI rates have increased by 7%.

7.4 What actions were implemented as a result of target setting?

The success of a road safety target is dependent on other policies and interventions that are implemented as part of the wider road safety strategy. To be most successful these measures must have a high level of effectiveness and be addressing large road safety problems and in order to judge the impact of the adoption of a casualty reduction target it is beneficial to investigate the measures that are put in place. This brings challenges since a country with previously a poor road safety performance may be able to implement well known measures that are highly effective. On the other hand, a country with a long track record of road safety may have already established a strong road safety management process and the remaining problems may be more challenging. Even when measures that are known to be effective are selected, the final impact on safety will depend on the manner of implementation as even a very well evaluated measure may not be effective if it is not well implemented.

An additional factor which may determine the success of a road safety policy is the manner in which progress is monitored. All road safety strategies include regular monitoring of changes in crash and casualty total numbers. Normally fatalities are monitored and often there are casualty sub-groups and specific types of crash that are also scrutinised. Less often countries will use performance indicators to measure progress in relation to the measures and policies within the strategy.

Much of the necessary information that is relevant to the implementation of road safety strategies is not available publicly, so the questionnaire and interviews were used to gather information from the road safety experts. While this is a useful method to obtain views, it can be less effective when consistent information is required but only subjective judgements are available. Nevertheless, the responses of the experts were used to gather information on the measures that were put in place following the adoption of a target and the manner in which progress was monitored. These responses are summarised in Table 7.

The experts identified infrastructure improvements as the most frequent response to the adoption of targets within the context of the 2010 road safety strategies with 59 policy developments reported across the 31 countries reporting. Changes to traffic laws (45 responses) and improved safety standards (42 responses) were also reported. Thirteen countries reported the adoption of the Safe System approach into the national strategy. Only one country, Croatia, was reported by the experts to have improved its post-crash responses.

Figure 17 shows the relationship between the total number of interventions identified for each country and the reduction in fatalities between 2010 and 2019. The low value of R^2 (0.0999) indi-

cates that essentially there is no association between the factors. This result may appear counterintuitive however there is a wide variation in the types of measures that were introduced, the measures themselves may have been implemented differently in each country, and different measures may have different levels of effectiveness. For example, a measure to increase traffic law enforcement in one country may be a local policing measure while in another country might be a national installation of safety cameras at known crash locations.

Table 7: Measures introduced following adoption of 2010 target

Country	Traffic law enforcement	Changes to traffic law	Adoption of Safe system	Increased penalties	Education and campaigns	Coordination of government strategies	Improved safety standards	Infrastructure improvements	Improved post-crash response	Driver licence acquisition standards	Total policy interventions
Belgium	2	3	0	2	6	0	1	2	0	1	17
Bulgaria	0	1	0	0	0	0	0	2	0	0	3
Czech Republic	2	2	0	1	0	0	1	1	0	1	8
Denmark	0	1	1	0	0	0	0	1	0	0	3
Germany	0	6	0	4	1	0	2	4	0	1	18
Estonia	0	0	0	0	0	0	0	6	0	0	6
Ireland	1	0	0	3	4	0	3	0	0	0	11
Greece	1	0	0	0	0	0	0	0	0	0	1
Spain	4	2	0	4	2	0	6	0	0	1	19
France	1	5	0	0	3	0	2	3	0	1	15
Croatia	1	0	0	0	0	0	2	0	1	0	4
Italy	1	0	0	0	0	0	0	0	0	0	1
Latvia	0	2	0	0	0	0	1	1	0	0	4
Lithuania	0	0	0	0	0	0	1	2	0	0	3
Luxembourg	1	0	1	2	1	0	0	4	0	0	9
Hungary	4	3	0	1	0	0	0	0	0	0	8
Malta	1	0	0	0	0	0	1	0	0	0	2

Country	Traffic law enforcement	Changes to traffic law	Adoption of Safe system	Increased penalties	Education and campaigns	Coordination of government strategies	Improved safety standards	Infrastructure improvements	Improved post-crash response	Driver licence acquisition standards	Total policy interventions
Netherlands	0	1	1	0	0	0	1	8	0	3	14
Austria	1	6	2	0	3	0	0	2	0	0	14
Poland	3	0	1	2	2	0	4	1	0	0	13
Portugal	1	0	0	0	0	0	0	1	0	0	2
Romania	0	0	0	0	0	0	1	1	0	0	2
Slovenia	1	0	1	2	4	0	3	2	0	0	13
Slovakia	0	0	1	0	0	0	2	5	0	0	8
Finland	1	2	1	1	1	0	2	2	0	1	11
Sweden	2	1	1	0	0	0	1	1	0	0	6
Australia	4	1	1	1	1	1	2	1	0	0	12
Norway	1	0	1	0	0	0	0	4	0	0	6
New Zealand	2	5	1	3	3	0	3	5	0	4	26
Switzerland	1	3	0	1	0	0	1	0	0	0	6
Canada	1	1	0	2	0	0	2	0	0	0	6
Total	37	45	13	29	31	1	42	59	1	13	

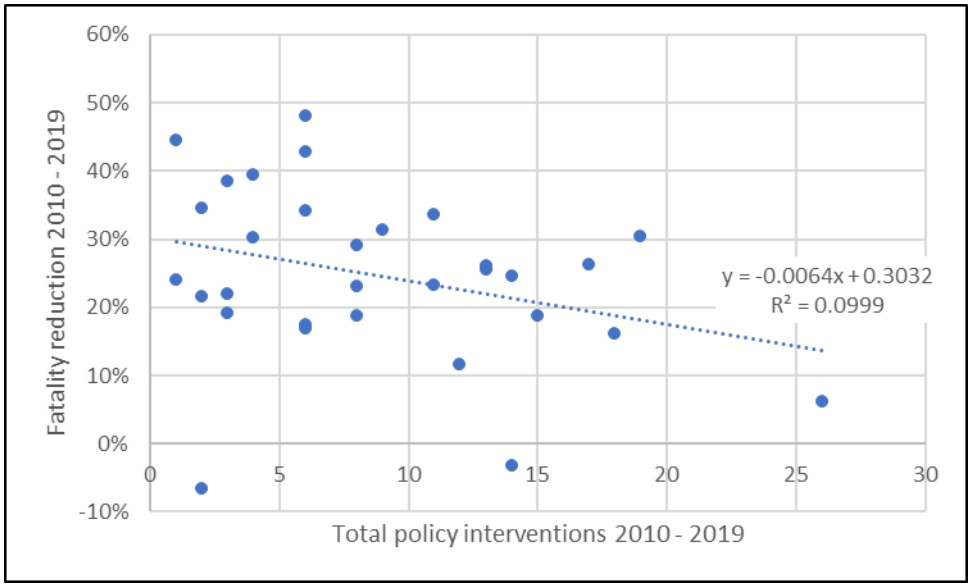

Figure 17: Relationship between total policy interventions and fatality reduction

7.4.1 Baseline dates

Baseline dates for target setting were commonly linked to the commitment of countries in the European Union to reduce road fatalities by 50% by 2020. Half of the countries with an overall fatality reduction target (17 out of 34) have targets with baseline dates that are closely aligned to the baseline dates of the aforementioned EU 50% reduction targets. To clarify, these countries seek to reduce their fatalities by a fixed number or by a fixed percentage from either 2010 to 2020 or from 2011 to 2020. The remaining countries (17 out of 34) set baseline dates for targets that overlapped the 2010 to 2020 time period.

7.4.2 How targets were monitored - Safety performance indicators and outcome measures

The World Bank[xxxii] has recommended that a safety performance framework should include a monitoring procedure that includes regular reviews of both final outcome measures and safety performance indicators (key performance indicators). The road safety experts reported that many countries chose to monitor road safety progress and that these were normally selected as intermediate outcome measures of performance in addition to the use of an overall fatality target. The World Bank has highlighted the hierarchy of targets as below:

- **Final outcomes** can be expressed as a long term vision of the future safety of the road traffic system (e.g., as in Vision Zero and Sustainable Safety) and as more short to medium-term targets expressed in terms of social costs, fatalities and serious injuries presented in absolute terms and also in terms of rates per capita, vehicle and volume of travel.
- **Intermediate outcomes** are linked to improvements in final outcomes and typical measures include average traffic speeds, the proportion of drunk drivers in fatal and serious injury crashes, seatbelt wearing rates, helmet-wearing rates, the physical condition or safety rating of the road network and the standard or safety rating of the vehicle fleet.
- **Outputs** represent policy related deliverables that seek improvements in intermediate and final outcomes and typical measures include kilometres of engineering safety improvements, the number of police enforcement operations required to reduce average traffic speeds and the number of vehicle safety inspections, or alternatively they can correspond to milestones showing a specific task has been completed.

Table 8 shows the numbers of final outcome measures used to monitor progress above the minimum of the total fatalities and it can be seen that the country response to monitoring needs varies considerably with four of the country experts reporting over 10.

Table 8: Number of indicators used to monitor country performance

Country	Total indicators used for annual progress monitoring
Australia	23
Belgium	4
Bulgaria	1
Canada	0
Czech Republic	3
Denmark	13
Estonia	4
France	4
Finland	8
Greece	2
Italy	3
Latvia	3
Lithuania	5
Luxembourg	1
Malta	6
Netherlands	3
Norway	5
Poland	5
Portugal	5
Romania	1
Slovakia	2
Slovenia	5
Spain	10
Sweden	11
Switzerland	3
Total	130

The nature of the final outcome indicators that are used across the countries surveyed by the road safety experts is shown in Table 9. The table shows that typically these indicators include

- Counts of fatalities across sub-groups of interest
- Counts of fatalities on specific road types or environments
- Counts of fatalities with specific risk factors involved
- Fatality rates by population or registered vehicles

The experts rarely reported the use of indicators related to non-fatal casualties.

Table 9: Nature of final outcome targets used to monitor progress across countries surveyed

- Reduction in fatalities, and non-fatalities in selected corridor sections
- Deaths involving single vehicles
- Deaths involving heavy vehicles
- Deaths of bicyclists
- Deaths of pedestrians
- Deaths of motorcyclists
- Deaths of drivers aged 17-25
- Deaths of drivers aged 65+
- Deaths from crashes involving a person aged 17-25
- Deaths from crashes involving a person aged 65+
- Number of road users killed and injured in accidents where at least one driver has a blood alcohol level above legal maximum
- Fatal crashes involving driver (or motorcyclist) with blood alcohol level above legal maximum
- Vehicle occupants killed who were not wearing a seatbelt
- Fatal crashes involving an unlicensed driver
- Fatal crashes involving driver with illegal drug in system
- Deaths of drivers with illegal drugs in system
- Deaths on metropolitan roads
- Deaths on regional roads
- Deaths on remote roads
- Deaths from crashes at intersections
- Deaths from crashes at intersections on rural roads
- Deaths from head on crashes
- Fatalities per billion vehicle km
- Number of road accidents resulting in fatalities
- Number of fatalities per 10 000 licenced vehicles
- Number of fatalities per 1,000,000 people

The World Bank also recommends that progress to targets is monitored by the derivation of Safety Performance Indicators which measured the outcomes of policy actions. The road safety experts stated a wide range of safety performance indicators and/or outcome measures has been set by the countries analysed. A comprehensive list of SPI's and outcome measures for each country has been assembled as reported by the experts however there was no institutional source available to provide a definitive list. It was not possible to ascertain when in the decade these were established so only limited analysis of the impact of these monitoring measures is possible. The SPI's mainly fall into the following categories:

- Implementation of road safety policy actions (e.g. Number of successfully delivered road safety education campaigns).
- Vehicle safety standards (e.g. percentage of motorcycles with ABS).
- SPI's for driver behaviour (e.g. Proportion of drivers exceeding speed limit by at least 10km/h, Proportion of driver or front seat passengers wearing seat belts, Proportion of cyclists wearing helmets, Fatal crashes involving driver (or motorcyclist) with blood alcohol level above legal maximum, Fatal crashes involving an unlicensed driver).
- Limited number of miscellaneous SPI's (e.g. Number of road accidents resulting in fatalities, Share of safe pedestrian, cycle and moped crossings on municipal roads).
- A small group of SPI's and outcome measures have consistently been measured across a substantial number of countries in the EU. These include 'Number speed tickets per 1000 population,' 'Percentage of speed offenders per road type,' Share of traffic volume within speed limits, by road type,' 'Mean speed per road type,' and 'Percentage tested over the speed limit.'

The OECD recommends that safety performance indicators should reflect the traffic safety problems in each country, although there are benefits to international comparisons where similar calculation methods can be employed. The road safety experts identified a wide range of SPIs and these are listed in Table 10: Range of Safety Performance Indicators in use reported by experts to illustrate the indicators that are already in use. It can be seen that there are already SPIs corresponding to most of the five pillars are in use.

Table 10: Range of Safety Performance Indicators in use reported by experts

Safe Roads and Roadsides

- No indicators used

Safe Speeds

- Percentage of speed offenders per road type (x3)
- Mean speed per road type
- Average driving speeds, in 80 kph and 100 kph speed limit zones
- Speeding compliance including proportion of trips exceeding the speed limit
- Proportion of drivers exceeding speed limit by at least 10km/h
- Share of traffic volume within speed limits (national roads)
- Share of traffic volume within speed limits (municipal roads)

Safe Vehicles

- Average age of vehicle fleet or average age of passenger vehicles
- Percentage of new light vehicles sold with a 5-star rating
- Percentage of new vehicles sold with Autonomous Emergency Braking (AEB)
- Percentage of safe motorcycles (ABS)

Safe Road Use

- Number of successfully delivered road safety education campaigns
- Number of joint operations between road traffic enforcement forces and road safety agency
- Proportion of drivers who admit to engaging in distracting actions while driving
- Seatbelt use compliance by seating position
- Child restraint compliance
- Proportion of adult cyclists wearing helmets

- Proportion of cyclists wearing helmets
- Proportion of moped drivers wearing helmets
- Proportion of motorcyclists wearing helmets
- Drink driving compliance and drivers (and motorcyclists) with blood alcohol level above legal maximum

Post-Crash Care

- Number of hospitals that have emergency response protocols

Annex 3 shows a complete listing of the final outcome and SPIs that the experts reported were in use in each of the countries with responses.

The European Commission announced a new reduction target for serious road traffic injuries between 2020 and 2030 of a 50% reduction. According to the 14th Road Safety Performance Index Report published by the ETSC[1], 18 countries have fully drawn up, or began to prepare, national road safety strategies for 2020 onwards. Table 11 compares the progress of each country towards the formation of their new national road safety strategy, including the baseline dates of the strategies and the nature of the targets, according to the ETSC[1].

The EU's Road Safety Policy Framework 2021-2030 announced a new list of Key Performance Indicators (KPIs) which will assess collective road safety performance by building a clearer picture of overall safety of the road network. Specifically, multiple countries are already collecting (or plan to) data towards the new KPIs for progress monitoring and will set (or plan to set) outcome measures. Some of these KPI's and outcome measures are yet to be defined however, along with the data collection methodologies. The intention of the Road Safety Policy Framework 2021-2030 is for comparable data to be obtained across countries for each of these KPI's. The KPI's are as follows:

1. Speed compliance
2. The use of safety belts and child restraint systems
3. The use of protective equipment
4. Driving under the influence of alcohol
5. Driver distraction by handheld devices
6. Safety of new cars
7. Infrastructure safety
8. Post-crash care

In terms of the development of the KPI's currently in use and how comprehensive the data collection is for each of the KPI's, the KPI's for use of safety belts, speed compliance and use of protective equipment are well developed and more widely implemented. KPI monitoring for infrastructure safety, post-crash care and safety of new cars has a larger room for improvement across the EU countries. It should also be noted that variation in the methodologies used for KPI data collection exists. Table 11, from the 14th Road Safety Performance Index Report, lists the progress within each country towards the acquisition of the KPI's.

Table 11: Progress towards post-2020 road safety strategies – European countries

	New National Road Safety Strategy	Time period of new strategy	Road death reduction target	Serious road injury reduction target
AT	YES	2021-2030	YES (tbd)	YES (tbd)
BE	Under development	2021-2030	Under development	Under development
BG	YES	2020-2030	n/a	n/a
CY	YES	2021-2030	YES (tbd)	YES (tbd)
CZ	YES	2021-2030	EU target	EU target
DE	Under development	2021-2030	YES	LIKELY
DK	Under development	2021-2030	LIKELY	LIKELY
EE	Current 2016-2025		52% reduction	31% reduction
ES	YES	2021-2030	n/a	n/a
FI	Under development	2022-2026	n/a	n/a
FR	Current 2018-2021		n/a	n/a
EL	Under development	2021-2030	YES (tbd)	n/a
HR	YES	2021-2030	YES (tbd)	YES (tbd)
HU	Current 2020-2022		EU target	EU target
IE	YES	2021-2030	YES (tbd)	YES (tbd)
IT	Under development	2021-2030 (according to EU)	EU target (tbd)	EU target (tbd)
LU	YES	2019-2023	Vision Zero	Vision Zero
LV	Under development			
LT	YES	2020-2030	EU target	EU target
MT	Current 2014-2024		n/a	n/a
NL	YES	2018-2030	(tbd)	(tbd)
PL	Under development	2020-2030	n/a	n/a
PT	Current 2017-2020		56% reduction	178 per/mln inhabs
RO	Current 2016-2020		n/a	n/a
SE	Current 2007-2020		EU target	25% reduction
SI	Current 2013-2022		EU target	EU target
SK	Under development	2021-2030	EU target	EU target
UK	Current 2019-2021		n/a	n/a
CH	Current - no time limit		100 road deaths by 2030	2500 serious injuries by 2030
IL	Under development		n/a	n/a
NO	Current 2018-2021		Max. 350 road deaths and serious injuries	
RS	Current 2015-2021		n/a	n/a

Country codes: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Cyprus (CY), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Israel (IL), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Romania (RO), Serbia (RS), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), Switzerland (CH), U.K. (UK)

7.4.3 Views of the road safety experts on performance monitoring

The road safety experts also provided additional commentary on the nature of performance monitoring indicators. A high number (eight) stated that safety performance indicators should be set, to support the setting of road safety targets. These SPI's can be used to measure the actual implementation of road safety policy actions, to assess if governments have implemented the road safety improvements that they have committed to in their road safety strategies. Additionally, three experts proposed that vulnerable road user accident data should be used to support target setting in the future. It is also particularly useful for countries with a lower population to analyse serious injuries data as well as fatality data, as fatality counts can vary widely year on year.

Eight of the experts proposed that SPI's should be introduced in an effective road safety strategy, to measure progress towards any fatality reduction targets, while four of the experts said that SPI's would be introduced in the post 2020 road safety strategy in their country. It was suggested that a defined methodology for the measurement and monitoring of SPI's would be advantageous. One expert clarified that SPI's relating to driver behaviours would be introduced in their country (subject to approval, partly due to the cheaper cost of SPI's relating to driver behaviour compared to other types of SPI) that originate from the CARE European centralised database on road accidents resulting in injury or death, and are also based on the monitoring framework utilised by Sweden:

> *"The new 2020 onwards strategy will use 'copy and paste' SPI's from CARE groups at the European level, including speeding, alcohol use, use of helmets, seatbelt use. This is yet to be approved."*

Additionally, two experts (from two individual countries) clarified that SPI's relating to the successful implementation of road safety policy actions would be introduced, to be imposed directly on the transport agency in that country over the time period of the new strategy. The first of these experts referred to this performance framework as 'performance measures,' whereas the second of these experts labelled the measures constituting the performance framework as intermediate output targets within a 'crash analysis system'. Both of these experts referred to a framework that measured the actual 'in the field'/'on the ground' implementation of agreed upon road safety policy actions/interventions. These SPI's would have 'direct links to desired target outcomes':

> *"Target setting will be a joint effort between the [blank] transport agency and the ministry of transport, who will use certain performance measures on the transport agency, e.g. how much of the road network has been reviewed for speed, how many high risk intersections have been treated. These measures will contribute to target setting."*

> *"The monitoring framework for the [dates] period is still being worked on. It is likely to be monitored by the crash analysis system. It is expected that there will be intermediate output targets, for example km of median barriers installed, officer hours for road traffic law enforcement, number of breath tests issued."*

The experts reported that SPI's should be coupled with the political will to assign responsibility for their achievement and demand accountability from agencies.

Table 12: Progress towards collecting European KPIs – ETSC [1]

	1. Speed	2. Safety belt	3. Protective equipment	4. Alcohol	5. Distraction	6. Vehicle safety	7. Infrastructure	8. Post-crash care
AT	YES	YES	YES	n/a	YES	n/a	n/a	n/a
BE	YES	YES	YES	YES	YES	YES	YES	YES
BG	NO	NO	NO	NO	NO	NO	NO	NO
CY	YES	NO	NO	NO	NO	NO	NO	YES
CZ	YES	YES	YES	YES	YES	n/a	n/a	n/a
DE	n/a	YES	YES	n/a	n/a	n/a	n/a	YES
DK	YES	YES	n/a	n/a	n/a	n/a	n/a	n/a
EE	YES	YES	YES	YES	YES	NO	NO	NO
ES	YES	YES	YES	YES	YES	n/a	n/a	n/a
FI	YES	YES	YES	YES	n/a	YES	YES	n/a
FR	YES	YES	YES	YES	YES	YES	NO	NO
EL	NO	NO	NO	NO	NO	NO	NO	NO
HR	YES	YES	YES	YES	YES	YES	YES	YES
HU	YES	YES	YES	YES	YES	NO	NO	YES
IE	YES	YES	YES	YES	YES	NO	NO	NO
IT	n/a	YES	YES	n/a	n/a	n/a	n/a	n/a
LU*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
LV	n/a	YES	YES	n/a	n/a	n/a	n/a	n/a
LT	YES	YES	n/a	YES	YES	n/a	n/a	n/a
MT	NO	NO	NO	NO	NO	NO	NO	NO
NL	YES	Planned	Discussed	Discussed	Planned	Planned	Planned	n/a
PL	NO	YES	NO	YES	NO	NO	NO	NO
PT	NO	NO	NO	NO	NO	NO	NO	NO
RO	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SE	YES	YES	YES	YES	n/a	YES	YES	n/a
SI	YES	YES	YES	YES	NO	NO	NO	NO
SK	NO	NO	NO	NO	NO	NO	NO	NO
GB	YES	YES	YES	YES	YES	n/a	NO	n/a
CH	YES	YES	YES	NO	NO	NO	NO	NO
IL	YES	YES	YES	n/a	n/a	n/a	n/a	n/a
NO	YES	YES	YES	YES	NO	NO	NO	NO
RS	YES	YES	YES	YES	YES	NO	NO	NO

Country codes: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Cyprus (CY), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Israel (IL), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Romania (RO), Serbia (RS), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE), Switzerland (CH), U.K. (UK)

Of the four experts who documented that SPI's will be incorporated into the new road safety strategy in their country, one acknowledged that SPI's would not only appear in the new strategy, but would form the main basis of new target setting:

> *"In the new, upgraded Road Safety Strategy [dates], the key performance indicators will be set as the main road safety targets, in addition of number of road deaths and seriously injured persons."*

This finding holds particular importance to the outcomes of the current report, as this report recommends that SPI's are incorporated into the new GB road safety strategy. It is vital that SPI's are defined quantitatively, to elicit focus from politicians and stakeholders (noted by two experts), and to allow for yearly monitoring of progress (one expert). An example of a quantitatively defined SPI

would be the target of 95% compliance with seatbelt use. When this focus from politicians is attained alongside political will to 'assign responsibility for target achievement,' accountability from those responsible for action implemented will occur (one expert). When targets are supported by SPI's, a 'clearer picture of progress' is attained, allowing the governing body to identify areas of weakness that require improvement to allow for achievement of an overall fatality reduction target (noted by two experts, the first with experience as both a researcher in an NGO and as a government official and the second who is the head of a government department).

The necessary quantitative analysis of SPI's is however only possible if comprehensive and reliable accident data is available (mentioned by one expert). It should be noted that two experts, from two different countries, disagreed in their opinion on the usefulness of the setting of targets for serious injury reduction alongside the setting of overall fatality reduction targets. One expert posited that serious injuries and fatalities cannot be reduced simultaneously:

> *"The [reduction target] for serious injuries doesn't make much sense. Passive safety is much more successful than active safety – the number of fatalities shows a larger decrease than the number of serious injuries. On the other hand, people who survive a crash would belong to minor/serious injuries category. So, it is not so easy to decrease the number of serious injuries as they are associated with the number of deaths. To decrease both, at the moment, is almost impossible."*

A different expert did however postulate that reduction in all KSI's simultaneously was possible due to speed reduction strategies, shown by the historic accident data trends in their country:

> *"No, we have seen during the last 20 years, there has been a decline in all KSIs. We have been focussing on speeding as the main safety area – this has a very high impact on the seriousness of the accidents. If we reduce the speed, we can see a reduction in KSIs all round."*

7.4.4 Country responses to targets – impact on fatality outcomes.

This section has summarised the country responses to the adoption of targets by examining the numbers and nature of newly introduced road safety policies together with the SPIs and final outcome indicators used to measure progress. An examination of the relationship between the number of interventions and casualty reduction did not find a statistically significant correspondence (see Figure 17), most likely as a result in the high variation between the scale of the measures and the manner in which they were implemented.

There were indications that the adoption of a greater number of outcome measures was associated with greater casualty reductions, although not at a level that was significant. Figure 18 shows that the countries with an enhanced set of progress monitoring indicators sustained a slightly greater mean reduction in fatalities over the decade. Countries that only monitored total fatalities showed an average reduction of 18% over the decade compared with 26% for those countries with an improved framework although these differences are not statistically significant. The data provides an indication that countries that track road safety progress in greater detail are the countries that have higher levels of performance.

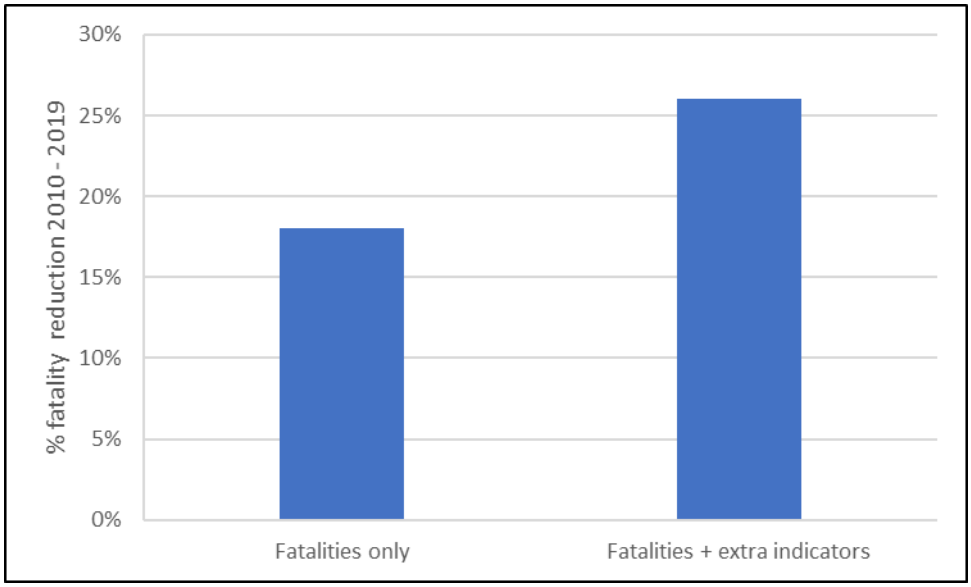

Figure 18: Reductions in fatalities between 2010 and 2019 for countries with an increased set of performance monitoring indicators.

The actions that were implemented as a result of target setting - summary

This analysis has shown that countries respond to the introduction of road safety targets with a wide range of policies and interventions. Many of the interventions are, of course, in-tended to reduce casualties while others are intended to improve the road safety management process. The previous history of road safety actions in a country is important when determining the most appropriate measures for a future strategy, a long track record of road safety actions may mean the priority areas are different from a country with less previously achieved. Despite several countries adopting the Safe System approach during the period under review there were very few that identified institutional level responses to a target. Al-most exclusively the measures that were put in place were traditional measures focussed on behaviour, infrastructure, enforcement and vehicles. It seems clear that there is more to be done to fully incorporate the Safe System approach into many countries' policymaking. The information gathered from the road safety experts also demonstrated a wide range of approaches to progress monitoring. While many countries routinely monitor several final outcome indicators there is a wide range used between countries. Far fewer countries also include SPIs amongst the progress indicators and again this is an indication that the Safe System approach has not yet fully been incorporated to national road safety management. Examination of the impact of the levels of monitoring has shown countries that monitor more outcome indicators beyond the total fatalities have shown a 26% reduction in fatalities between 2010 and 2019 compared to an 18% amongst those that only measure fatality changes although the result is not statistically significant.

8 Recommendations

8.1 What targets should be considered for wider roll-out in the UK?

The Safe System Approach to Road Safety Management, as detailed by Bliss and Breen[29] identifies a results focus as the overarching institutional function, the responsibility being that of the Lead Agency. Without a result focus all other institutional functions —coordination, legislation, funding and resource allocation, promotion, monitoring and evaluation, and research and development and knowledge transfer—will lack cohesion. The results focus evolves over time as monitoring and evaluation supports an improved understanding of national road safety performance. A safety performance framework brings institutional management activities together with the results focus by expressing the level of ambition for road safety and monitoring the progress towards medium and long-term goals.

Bliss and Breen[29] have identified five dimensions of the results focus:

1. Appraising current road safety performance through high-level strategic review.
2. Adopting a far-reaching road safety vision or goal for the longer term.
3. Analysing what could be achieved in the medium term.
4. Setting targets by mutual consent across the road safety partnership.
5. Establishing mechanisms to ensure partner and stakeholder accountability for results.

A recent Road Safety Management Capacity Review (RSMCR)[xxxiii] identified that the absence of a British safety performance framework resulted in unclear leadership, unclear ownership across stakeholders, unclear levels of ambition and unfocused coordination across government departments and with the wider stakeholder community. The RSMCR recommended that the adoption of the Safe System for British road safety management should be underpinned with an agreed national safety performance framework. This would

- Set out the long-term Safe System goal of working towards the ultimate prevention of deaths and serious injuries;
- Set interim quantitative targets to 2030 to reduce the numbers of deaths and serious injuries;
- Set measurable, intermediate outcome objectives for activities to 2030, for which there is a strong evidence base for a direct relationship to the prevention of death and serious injury and which are used by global road safety leaders.

The findings of this study, based on the international comparisons of road safety performance, recommendations of the road safety experts and the best practice guidelines from the UN, WHO and World Bank, fully support the recommendations of the RSCMR. The adoption of a safety performance framework has been found to be best practice amongst all major bodies adopting the safe system approach including the World Bank, World Health Organisation, United Nations, Organisation for Economic Development as well as regional bodies such as the European Union, countries including Norway, Sweden, Australia, Netherlands. All of the road safety strategies of the Home countries refer to the Safe System approach but currently none has a well-developed management framework of the type envisioned by the Capacity Review. International comparisons amongst OECD countries conducted within this review have identified that most countries are still in the early stages of adopting the Safe System approach and, like Great Britain, have yet to establish individual performance frameworks.

8.1.1 Road safety experts' views on future target setting

With regard to a long-term vision for road safety and interim targets most of the respondents to the questionnaire and the interviewees were highly supportive. Many commented that targets led to:

- Increased motivation amongst stakeholders
- Increased coordination
- A clearer level of ambition
- Increased accountability for road safety delivery
- A stronger application of evidence-based procedures and improved use of the most effective measures

but several also commented on

- Unrealistic top-down targets that became demotivating
- Lack of resources
- Challenges in applying Safe System at local level

By analysing long-term developments in road safety this study has also identified that a target alone will not achieve reductions in fatalities, these are impacted by wider societal trends in indicators such as Gross Domestic Product, the numbers of older road users, improvements in vehicle safety standards, and increases in population and registered vehicles. Against this a poorly established set of policy actions might have only marginal effect.

The road safety experts who responded to the online survey felt that certain groups or bodies should be more involved in road safety target setting. The most commonly cited group was University researchers/academics (five experts, five individual countries - two researchers, two government employees inc. head of government department, one NGO traffic engineer, four of which had experience of target development, monitoring and evaluation).

> *"Target setting means exploring the relationship between indicators (e.g. relationship between total fatalities and motorcyclists killed; or between casualties and safety performance indicators). This requires sound research."*

Additionally, three of the experts (from three countries) asserted that 'all bodies representing stakeholders' should be represented in the target setting strategy (all were or are government employees, one as a senior advisor for road safety and one as a traffic engineer, all with experience of experience of target monitoring and evaluation). Similarly, three experts recommended that all levels of government should be involved in target setting. It was asserted that the specific organisations managing the road safety improvement funds, such as the Ministry of Finance and the Traffic Police, should be aligned with the central governmental target setting strategy. When all bodies representing stakeholders are consulted, the result is carried by all:

> *"For our latest Strategic Road Safety plan we worked democratically with all kinds of bodies (private, public, consulting, enforcing, insurance and academic etc) Thus the result is carried by all."*

More specifically, survey responses indicated that public health organisations (two experts, two countries), driving schools (one expert) and fire departments (one expert) should have an input.

In contrast, one expert, with experience of target, development, monitoring and evaluation (both as a government employee and in NGO's) reported that it mattered less who was involved but that co-operation between the participating target delivery bodies was crucial:

> *"The 'Who' can remain the same. It is more that there is a problem of ownership, and consequently less political pressure to take new measures. There is also weak coordination across Ministries at Federal level, and between the Federal and the Regional level."*

8.1.2 Conditions to be met for the setting and delivery of effective, achievable, and realistic targets as part of road safety management strategy

As shown in Section 6.1.2, experts believed that strong political will, adequate funding and an ambitious but not unrealistic target, collaboration and SPIs were conditions conducive to target setting within a road safety management strategy.

Table 13: Conditions to be met for the setting and delivery of a road safety management strategy

Proposed condition to be met	Number of road safety experts who proposed this
Strong political will	8
Adequate funding	7
Ambitious but not unrealistic target	5
Collaboration between all stakeholders	5
SPI's (which will be introduced in the new road safety strategy in their country)	4
Increased road safety culture within the community'	3
Political consensus	3
Setting of intermediate targets	2
Forecasting of interventions and their expected effects	1
Availability of technical expertise in responsible agencies	1
An approach that is evidence based	1
Knowledge to estimate expected development in KSI's if no deliberate road safety interventions are implemented done'	1
Local government involvement	1
Targets should be easy to understand	1
Targets should be cost effective	1
Cooperation from the media to keep the focus on road safety	1

Collaboration between all stakeholders was frequently cited by the experts. Five participants noted that existing road safety strategies in their country had been weakened by a lack of collaboration within government ministries and between government ministries and regional governing bodies. Similarly, a historical lack of cooperation between stakeholders was stated by five respondents as a barrier to the road safety strategies in their country. One expert advisor in an NGO clarified which some of the types of stakeholders that would need to collaborate by providing specific examples:

> *"The most successful actions are made in cooperation: for example, speed reduction, it has the best effect when road engineering, police control and campaigning go hand in hand."*

Another expert stressed the important of 'teamwork' amongst stakeholders at national as well as local levels:

> *"Teamwork and dedication of all road safety stakeholders at the national and local levels."*

Forecasting of interventions and their expected effects was also suggested to be a crucial component of a road safety strategy. One country is currently forecasting accident rates and financial costs based on the projections of 3 to 4 scenarios that include the implementation of various road safety interventions.

It was proposed by one expert that local governments should play a role in the deliverance of effective road safety strategies. It is advisable for these local strategies to be aligned with the national strategy, for example by mirroring preventative campaigns at the local level:

> *"All local governments must follow all preventative campaigns conducted by the traffic safety agency. These campaigns are modified to fit the local government."*

Alongside the proposed conditions that are conducive to effective road safety strategies, the respondents referred to barriers that the traffic safety agencies in their countries had encountered when implementing strategies. One expert cited political corruption, and another expert named a lack of a road safety culture within the general population. The client should therefore note that governments should aim for the cited conditions that are conducive to successful target setting road safety strategies, and also aim to curtail the potential barriers to successful strategies.

Recommendation

The DfT is recommended to build on the adoption of the Safe System approach and establish a national road safety performance framework. It should reconfirm the ultimate goal of the prevention of all deaths and serious injuries, establish interim quantitative targets for 2030 and it should set a series of intermediate outcome targets, closely aligned to the main policy actions and long-term goal and interim targets, to drive and monitor progress.

8.2 What are the key suggested methods for target implementation and delivery?

Road safety targets must be ambitious but achievable if they are to be successfully implemented by stakeholders. They signal the level of ambition for safety and can provide the framework for cross-governmental coordination. They can be the link with the wider safety community of stakeholders and practitioners providing motivation and direction.

Countries define their targets using several different approaches. Regional bodies such as the United Nations and European Union have adopted a final outcome target having followed a process based on agreement by constituent countries. Most frequently the target has been a 50% decrease in fatalities over a 10-year period but more recently attention has also been paid to seriously injured casualties following the adoption of a standard definition. These targets have not been based on a science-based plan but are backed up with a higher-level strategy. They are predominantly aspirational but are intended to drive furthermore detailed planning at national level. They have been most effective when used to kick-start new attention and motivation to address traffic deaths and injuries.

More commonly targets are established based on a more analytic approach that is combined with estimates of improvements from a combination of safety interventions. The model used in Australia and elsewhere has been developed over a 15-year period and is currently being used to support the new road safety strategy to 2030[xxxiv] [xxxv]. This is outlined in Figure 19 below.

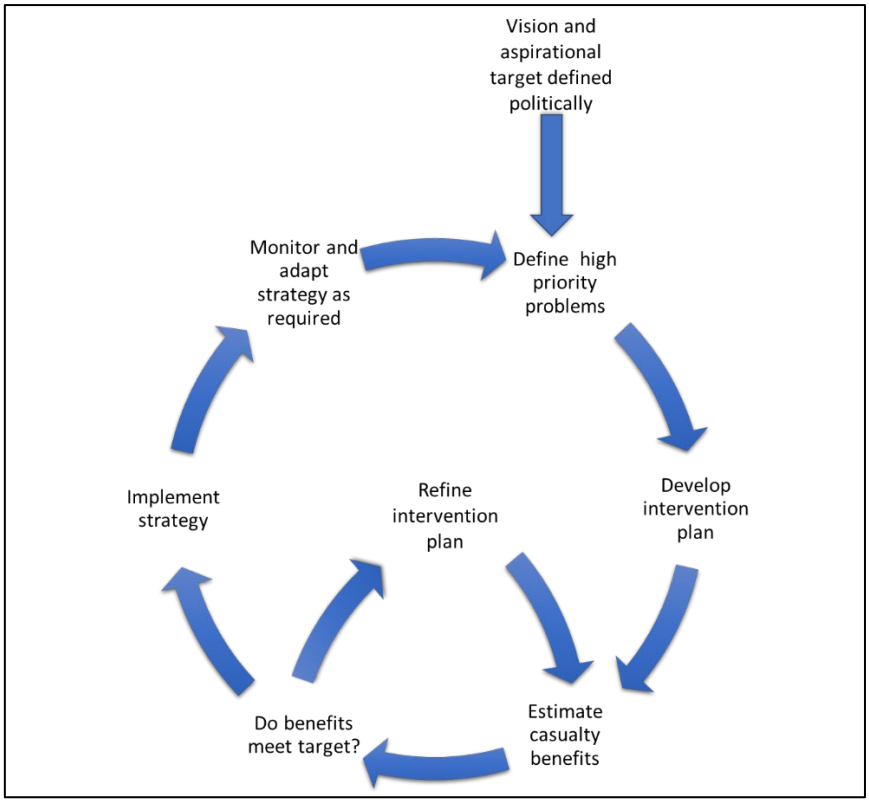

Figure 19: Target setting approach used in Australia

Under the Australian model the overall level of ambition of the safety strategy is established within political dialogue involving the top management of government and the key stakeholders. An initial plan of policy actions and interventions is then developed on the basis of expected results, feasibility and affordability. This plan is then modelled using the best evidence-based estimates of known effectiveness of interventions, if the plan appears to enable the target to be met it is then implemented but further adjustment may be necessary if it falls short. Final outcome and intermediate outcome monitoring takes place over the period of the plan and further adjustments are made to ensure the target is met.

Elvik (2008)[xxxvi] reviewed the management-by-objectives approach as applied to road safety policy and identified several conditions for its success.

- The top management of government should strongly endorse the targets and make a firm commitment to realising them.
- The targets set should be challenging, yet in principle achievable.
- There should not be too many targets in view of the available policy instruments designed to realise them.
- The agency or agencies given the task of choosing how best to realise the targets should have authority to determine the priority to be given to all available policy instruments.
- Responsible agencies should be supplied with sufficient funding to implement all cost-effective road safety measures.
- There should be a system for monitoring progress in realising targets and providing feedback to responsible agencies on their performance.

- Incentives should exist to ensure commitment to targets from all agencies responsible for realising them.

Recommendation

The DfT should apply an empirical approach to setting new road safety targets as part of a wider strategy related to a new road safety plan. The process to establish these targets should be based on an approach that ensures that the political vision is supported by interim targets and a concrete implementation and monitoring plan. Targets should be developed on the basis of political will and a programme of interventions and policies. Progress towards the targets will be monitored through the use of Safety Performance Indicators and final outcome measures.

8.3 What methods should be considered for the long-term monitoring of target impact?

It is unlikely that a safety strategy can be established at the start of a 10-year period and achieve the expected results without any further development. While there does exist a wide range of knowledge about the effectiveness of many safety interventions there is more limited knowledge of transferability between settings. Furthermore, the nature of the road safety problem may change with changing patterns of road use, new mobility patterns and the introduction of new technologies and vehicle types. It is essential to monitor the implementation of the road safety plan, developments in road safety and casualties for several purposes:

- To compare against the expected progress towards the target casualty reductions
- To evaluate the effectiveness of the implementation of the measures
- To gather data to underpin the development of new road safety interventions to address emerging problems
- To provide feedback to stakeholders and practitioners
- To maintain coordination between Government Departments and with key stakeholders

The monitoring framework therefore must be coherent with the goals and ambitions of the safety strategy and targeted at changes in casualty totals and the institutional processes within the strategy. This can be achieved by maintaining annual records of final outcomes measures that enumerate total killed and seriously injured road users as well as the numbers within the key sub-groups identified as the high priority problems. Many road safety interventions take time to become established and to achieve the final effectiveness and there is often a lag of several years between the introduction of a measure and the evaluation of its effectiveness. For this reason, the development and application of a series of Safety Performance Indicators (SPIs) as a management tool enables policy-makers to understand the state of the road safety system and to manage for ambitious road safety results.

SPIs have been defined as "…. measures (indicators), reflecting those operational conditions of the road traffic system, which influence the system's safety performance" (Gitelman et al., 2007[xxxvii]; SafetyNet, 2008[xxxviii]). They are observable measures that have a known quantitative relationship with crashes through a causal relationship and aim to measure the prevalence of conditions of risk across the traffic system. They have the advantage in that they are more responsive indicators to the application of measures than final outcomes. An example is the case of speed related deaths and injuries – speed is known to be a major factor in accident causation, yet any individual crash may be a result of many factors that include excess speed. It is therefore difficult to measure the impact of

speed reduction interventions by investigating crashes and identifying speed related factors. A results-focussed monitoring policy will include measures of travel speeds under normal road conditions and will identify developments in excess speed.

There are a number of considerations to be taken into account when developing a framework for SPIs-

1 Each of the major road safety risks should have an associated SPI to measure progress towards mitigating the risk. Research has already identified many of the existing road risks including excess speed, alcohol, and lack of restraint use.

2. The recommended SPIs cover key road risks that have been identified through crash investigation however new risks may emerge over the course of a 10-year road safety strategy or our understanding of risks may improve. For example, current trials of eScooters, if successful, may substantially increase the number of these vehicles in use in cities bringing new road safety risks. SPIs are therefore considered to be part of a dynamic monitoring system that develops and reflects changing priorities.
3. SPIs are a measure of policy actions. A road safety strategy will incorporate a series of interventions and measures that are intended to result in changes to traffic and the manner in which traffic systems are used. Effective interventions that are well-implemented should result in changes in the traffic system that are measurable. For example, a policy to reduce motorway crashes might focus on reducing travel speeds through the use of speed enforcement methods. A relevant SPI would be the percent of vehicles travelling above a selected speed on the target roads.

4. SPIs have a known quantitative relationship with crashes. Indicators such as blood alcohol and driving speed are well researched and there are clear relationships established between the measure and the level of road risk. Other risk factors, such as fatigue or distraction, do not have a known relationship with crashes and in fact are only measurable under experimental conditions. There are therefore few useful SPIs currently available for these risk factors.

5. SPIs are measurements of the traffic system and the manner in which it is used. Much data is already available and some is suitable for use as an SPI. Other data may not yet be available through existing monitoring and may require new procedures to be established. The precise calculation of an SPI is dependent on the data collection methodology which has to be incorporated within the wider traffic system monitoring framework. Where possible there are advantages to the adoption of accepted methods to aid international comparisons.

6. An SPI is a measure of progress and has considerable value to road safety monitoring even without targets being set. Nevertheless, a science based overall road safety target will rely on casualty reductions across many risk areas and these must all be achieved in order to reach the final outcome target.

7. An SPI may have a specific value that represents the expectation for progress towards the overall target. Some countries, such as Sweden and Norway, do use SPIs as targets within the period of a road safety strategy while others such as the EU propose them to be indicative and a more general measure of progress.

8. Most countries that use SPIs as intermediate indicators do not choose a large number. Too many SPIs may reduce focus and political support, particularly if the associated target population of crashes are relatively small.

9. There are many risks in driving that are normally unobserved and unquantified. These may account for many of the lower level mistakes and system insufficiencies that are associated with crashes yet are not the high-risk behaviours. Some of these may be expected to increase, for example with the increasing penetration of automation systems into the vehicle fleet. A

deeper investigation of such risks is needed to ensure that they are properly identified and quantified to enable suitable SPIs to be developed.

10. Many SPIs may be derived from existing transport and traffic data that is routinely gathered as part of the transport policy evidence base. Some SPIs may require additional data to be gathered to address key information gaps.

Several countries and regions have adopted a monitoring framework that incorporates SPIs alongside final outcome measures. The European set of indicators adopted to support the casualty reduction strategy to 2030 is shown with the current Norwegian and Swedish SPIs in Annex 4. These examples illustrate the range of types of SPI that are now in use. The SPIs have been introduced relatively recently and there has been little evaluation of their effectiveness, so it is not possible to identify a preferred type. Nevertheless, it can be seen that all examples of SPI are focused on the safety performance requirements specific to each country. Some, such as many of the Norwegian SPIS, are very close to specific measures that are planned for the future safety strategy. Others, such as the EU recommended set, are much more general and focus more on risk factors observed in normal driving. Importantly it should be observed that both Norwegian and Swedish SPIs are used as intermediate outcome targets as well as for monitoring purposes. The Annex also shows a set of SPIs recommended by the Parliamentary Advisory Council for Transport Safety (PACTS). While these are generically sound and the development has been made with consideration of the feasibility to gather the data, they do not include measures that directly address Vulnerable Road User safety, which is expected to be increasingly important as mode choice moves towards active travel.

Most recently Breen et al (2018)[xxxix] have developed a set of SPIs to form the basis of future monitoring and targets for European Countries. These SPIs are shown in Table 14 and are the recommended SPIs to be applied in Great Britain. The SPIs have the advantage that they are structured according to the five Safe System pillars and also include SPIs directed at cyclists, although further development is needed to define an appropriate SPI for pedestrian safety. The recommended SPIs are similar to those developed by the Parliamentary Advisory Council on Transport Safety however several indicators are more specific. In addition to indicators related to vehicles travelling above the speed limit the indicators also refer to roads with speed limits that are based on safe system principles rather than the traditional 85 percentile speed measures. Finally, the proposed indicators also include a measure that relates to cyclist safety.

Table 14: Recommended Key Performance Indicators

	SPI from Breen et al	Comment on possible data sources and ease of collection
1	Proportion of traffic volume on the strategic road network and other roads of importance with a 3-star or better Euro RAP rating.	Highways England data NB: HE has a similar SPI
2	Proportion of traffic volume with drivers travelling within the speed limit on urban roads, rural roads, motorways.	DfT Vehicle speed compliance statistics reported annually
3	Proportion of traffic volume on urban, rural, motorways within speed limits which are 'safe and credible'.	Achieved by combining speed compliance data with allocated speed limit data according to safe system specification
4	Proportion of new passenger cars with a 5-star Euro NCAP rating.	Achieved by combining vehicle registration data with public EuroNCAP ratings
5	Proportion of seriously injured road crash victims with access to professional medical assistance within 15 minutes of notification.	NHS ambulance Quality data published monthly, potentially merged with Hospital Episodes data (this requires further investigation)
6	Proportion of motor vehicle occupants using a seat belt in a) front seats and b) rear seats	Requires representative roadside survey
7	Proportion of correct use of child restraints by child occupants	Requires dedicated representative survey
8	Proportion of a) motorcyclists, b) moped users and c) pedal cyclists with correct use of a protective helmet	Requires representative roadside survey
9	Proportion of drivers and riders of motorised vehicles without alcohol above the legal limit or other drugs which impair driving.	Home Office annual data on breath tests, DfT annual data on alcohol related crashes, data on self-reported drink and drug driving collected via the Crime Survey for England and Wales
10	Proportion of drivers not using smartphones or other mobile devices while driving, ideally this will cover any use (both hands free and handheld)	Requires further investigation for the measurement of hands free use specifically but it will likely involve an annual roadside use survey combined with surveys measuring self-reported use, such as that collected via the Crime Survey for England and Wales

Recommendation

It is recommended the DfT develop a set of Safety Performance Indicators which are inter-mediate outcome measures as quantified intermediate outcome targets and for progress monitoring purposes. They will quantify the expected results of road safety policies and interventions that are key to future revisions of the British Road Safety Statement. They will reinforce the availability of final outcome measures. These SPIs should measure the changes in road safety risk factors that are related to policies and interventions, which are key measures in future casualty reduction strategies, and also

have a quantified relation-ship with deaths and serious injuries. The SPIs should be focussed on British road safety priorities but where relevant should adopt standard definitions to enable international comparability. The recommended SPIs are

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 above the legal limit or other drugs which impair driving.

10. Proportion of drivers not using smartphones or other mobile devices while driving

Recommendation

It is recommended the DfT develop a set of Safety Performance Indicators which are intermediate outcome measures as quantified intermediate outcome targets and for progress monitoring purposes. They will quantify the expected results of road safety policies and interventions that are key to future revisions of the British Road Safety Statement. They will reinforce the availability of final outcome measures. These SPIs should measure the changes in road safety risk factors that are related to policies and interventions, which are key measures in future casualty reduction strategies, and also have a quantified relationship with deaths and serious injuries. The SPIs should be focussed on British road safety priorities but where relevant should adopt standard definitions to enable international comparability.

The recommended SPIs are

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 above the legal limit or other drugs which impair driving.
10. Proportion of drivers not using smartphones or other mobile devices while driving

9 Summary of recommendations

It is recommended that:

1. DfT considers building on the adoption of the Safe System approach to establish a national road safety performance framework, which:
    - reconfirms the ultimate goal of the prevention of all deaths and serious injuries
    - establishes interim quantitative targets for 2030
    - sets a series of intermediate outcome targets, closely aligned to the main policy actions and long-term goal and interim targets, to drive and monitor progress

2. An analytical approach is used to establish the road safety performance framework. Under this approach, targets are based on political vision, underpinned with interim targets and a concrete implementation and monitoring plan. The process comprises the following stages:
    - Aspirational level of casualty reduction established at political level
    - Definition of high priority road safety problems
    - Development of plan for interventions and policies
    - Use of best evidence on effectiveness available estimate likely benefits and adjust measures until the expected overall reductions match.
    - Preparation of a set off SPIs based on the set of interventions – each major intervention area should have an accompanying SPI

3. DfT considers developing a set of SPIs – these are intermediate outcome measures, which quantify the results of the road safety policies and interventions and allow DfT to monitor progress towards its road safety targets. In order to allow international comparison and follow best practice, the SPIs should be based on Breen et al (2018).

4. DfT considers developing further SPIs that focus on pedestrians, cyclists and other vulnerable user groups.

10 Acknowledgements

The authors would like to thank Professor M. Quddus of Loughborough University for advice and support in connection with the statistical analysis conducted for this study. They would also like to thank all of the subjects who responded to the questionnaire and were available for the in-depth interviews at a time when societal concern was principally on the Covid-19 pandemic.

11 Terminology

This report uses the term “accident” to describe the events around a traffic collision that lead to death and injury. This is done on the basis that the term is widely used in the research and popular literature. The World Health Organisation, United Nations, European Commission, and other internal

bodies all agree that deaths and injuries from traffic collisions are almost all preventable. The Safe System Approach to Road Safety Management is based on this fundamental agreement.

12 Annex 1 –Safe System approach to road safety management

The goal of the Safe System approach is to create a traffic environment that is resilient to human error and maintains collision forces below the levels where serious or fatal injuries are sustained. Countries such as Sweden, Norway, Netherlands and Australia that have adopted the safe system approach aim to eliminate both fatal and serious casualties. Corben et al. (2010)[xl] propose that a transport system that tolerates consistently high levels of serious trauma is unethical and risks 'perpetuating the acceptance of failure.' The Safe System approach is illustrated in Figure 20 and is usually backed up by quantitative fatality reduction targets, often over 10-year periods, and a supporting framework of intermediate outcome measures/SPI's that are directly related to road casualties (PACTS, 2020)[xli]. Examples of outcome measures/ SPI's include measurements of driver behaviour such as speeding and seatbelt use, vehicle safety standards, safety quality of roads and roadsides, level of emergency response etc.

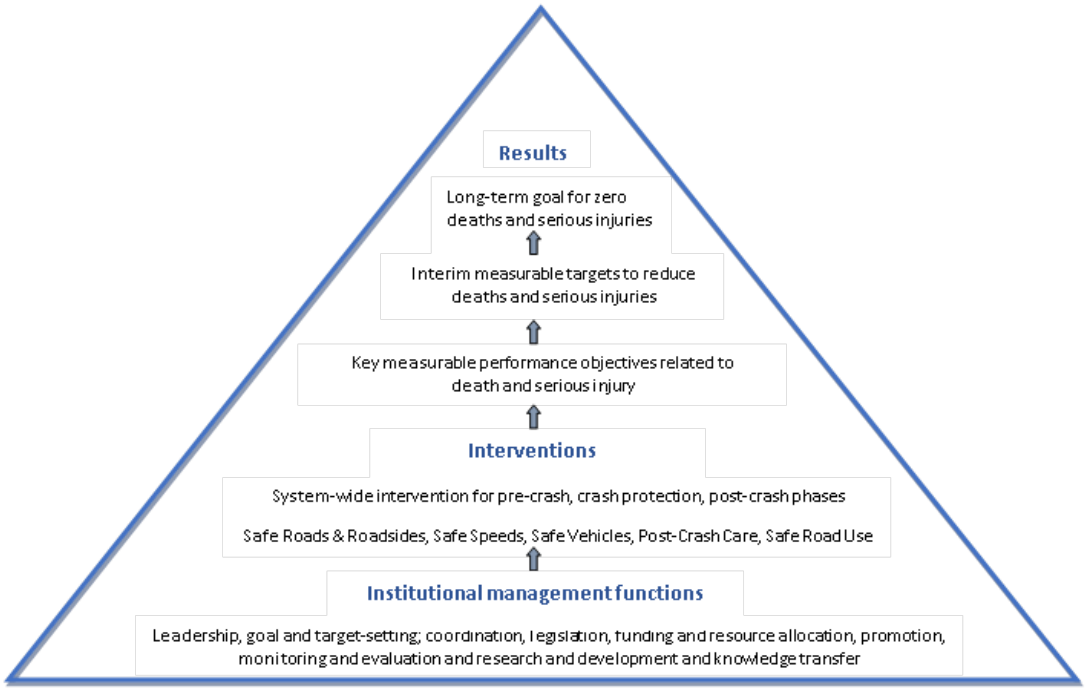

Figure 20: Safe System results, interventions, and delivery framework [36]

As discussed by Corben et al. (2010) [37], the Safe System approach is underpinned by four main principles.

- The first is to fully recognize the limited intrinsic capabilities of humans. Traditional road safety strategies have aimed to prevent human error and failures, for example by administering breath tests and speed checks. These programs have been successful to a degree, however other types of errors such as poor gap selection at intersections, and lane-keeping inability, are more challenging to eliminate and relate to these limited capabilities.
- The second is the acknowledgement of the limited biomechanical tolerance that the human body has towards violent forces during car accidents. If a limit is exceeded, the risk of a fatal or seriously injured casualty becomes high. A safe system road design acknowledges human errors to the extent that collisions would occur within biomechanically safe limits, ideally for non-motor car users also. Vehicles would also be designed so that occupants would be protected in common accident types and at usual speeds (below speed limit).

- Thirdly, road users would need to travel ‘safely’ by complying with road safety laws such as speed limits, maximum allowable blood alcohol levels, and seat belt and child car seat correct use. Road system designers would require this compliance.
- The fourth is that road design should be ‘forgiving,’ in that the laws of physics that control the movement of objects, and the unpredictability of these movements, should be acknowledged.

The safe system approach is based around three main delivery areas:

- Institutional management functions – these are the main policy areas under the responsibility of the Lead Agency
- Interventions – these are the system-wide policies and interventions that are put in place to reduce casualties
- Results – these are measures of the long-term goals and shorter term targets against which progress is measured.

A monitoring and evaluation framework to measures the outcomes of policy actions and progress towards targets and long-term goals is widely considered to be best practice and essential to under-pin road safety management.

13 Annex 2 – Impact of societal factors and policy interventions on road safety in GB

In order to examine the impact of previous road safety strategies on casualty outcomes a time series modelling approach was adopted. This enables the impact of each phase of road safety strategy to be calculated individually and also in combination with other potential influencing factors.

13.1 Time series analysis of accident data

Time series regression models were fitted to the reductions in fatality and KSI casualty rates to improve the distinction between the effect of each road safety strategy and the underlying background trend. An AR(1) model of the form

$$y_t = \beta_0 + \sum_{t=0}^{n} \beta_1 x_t + \epsilon_t \qquad \text{where } \epsilon_t = \rho\mu_{t-1} + e_t \qquad \textit{Equation 1}$$

with

- y_t is the forecast value of y at time t
- β_0 is a constant term
- β_1 is the coefficient of the value of the independent variable, in this case the presence of each strategy.
- ϵ_t is the error term
- ρ is the autocorrelation coefficient
- $\mu_{(t-1)}$ is the model error term
- e_t is the remaining random error term

The duration of each road safety strategy was introduced as a dummy variable to enable the changes over each strategy period to be compared with the previous. The analysis uses the Prais-Winsten method which accounts for serial autocorrelation in the data. Table 15 below shows the results for fatality rate while Table 16 shows the results for the rate of KSI casualties.

Table 15: Effect of successive road safety strategies on fatality rate

Model 1 – impact of 1987 strategy on fatality rate

			Unstandardized Coefficients					
Independent variable	Comparison range	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin Watson model fit
Strategy 1987 - 1999	1980 - 1986	0.848 (S.E. 0.129)	-1.859	0.712	-0.535	-2.610	0.018	1.023
Constant β_0			9.190	0.947		9.701	0.000	

Model 2 – Impact of 2000 strategy on fatality rate

			Unstandardized Coefficients					
Independent variable	Comparison range	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin Watson model fit
Strategy 2000 - 2010	1987 - 1999	0.775 (S.E. 0.138)	-1.031	0.553	-0.377	-1.864	0.076	0.883

Constant β_0			5.663	0.542		10.442	0.000	

Model 3 – Impact of 2011 strategy on fatality rate

			Unstandardized Coefficients					
Independent variable	Comparison range	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin Watson model fit
Strategy 2011 - 2018	2000 – 2010	0.887 (S.E. 0.115)	-0.099	0.284	-0.087	-0.349	0.732	1.145
Constant β_0			3.395	0.447		7.603	0.000	

Table 16: Effect of successive road safety strategies on KSI rate

Model 1 – impact of 1987 strategy on KSI casualty rate

			Unstandardized Coefficients					
Independent variable	Comparison range	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin Watson model fit
Strategy 1987 - 1999	1980 - 1986	0.730 (S.E. 0.166)	-14.387	5.218	-0.556	-2.757	0.013	1.372
Constant β_0			58.117	5.249		11.072	0.000	

Model 2 – Impact of 2000 strategy on KSI casualty rate

			Unstandardized Coefficients					
Independent variable	Comparison range	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin Watson model fit
Strategy 2000 - 2010	1987 - 1999	0.790 (S.E. 0.134)	-7.500	3.401	-0.434	-2.205	0.039	1.154
Constant β_0			35.089	3.459		10.144	0.000	

Model 3 – Impact of 2011 strategy on KSI casualty rate

			Unstandardized Coefficients					
Independent variable	Comparison range	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin Watson model fit
Strategy 2011 - 2018	2000 – 2010	0.877 (S.E. 0.120)	-1.908	1.601	-0.286	-1.192	0.251	0.933
Constant β_0			20.242	2.375		8.522	0.000	

Table 15 and Table 16 show the results of three models fitted each to fatality rate and the rate of KSI casualties. The independent variable took the value of 0 for the comparison period and 1 for the duration of the strategy. The Autocorrelation coefficient shows the amount that the rate at any time is influenced by the previous value and in all models was relatively high with values around 0.85, indicating the long-term trend is an important factor in casualty reduction. The earlier two strategies that were introduced in 1987 and 2000 were both highly statistically significant predictors of both fatality and KSI rates. In each case the model fit values were low to medium indicating the reliability was not high, although each was underspecified. The models for the final strategy, that was introduced in 2011, showed a poor fit and the influence of the strategy was not significant whereas the constant term remained highly significant.

These results show that the 1987 and 2000 road safety strategies, which included a casualty reduction target, were associated with a strong, unambiguous reduction in both fatality and KSI rates. There was no indication that the 2011 strategy was associated with any reduction in fatality or KSI rates.

13.2 Factors related to casualty reductions

The time-series analysis shows the underlying trends of the reductions in fatalities and KSI casualties and separates the impact of successive road safety strategies according to the presence of a target. Nevertheless, there may be other factors that influence casualty reduction in each of the periods and further analysis of societal information has the potential to provide further explanation.

Institutional data covering the years 1980 – 2019 was assembled from national and international sources and incorporated in multi-variate time-series models. This data is shown in Table 17 below together with the source and nature of the data.

Table 17: Institutional data for time series models

Data	Source	Unit	Notes
Annual road traffic	https://data.oecd.org/transport/passenger-transport.htm#indicator-chart [xlii]	Million passenger km travelled annually	UK level information
Total population	https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland	Million Persons	UK level information
Population 65years and over	https://data.oecd.org/pop/population.htm#indicator-chart[xliii]	Million Persons	UK level information
Gross Domestic Product	https://data.oecd.org/gdp/gross-domestic-product-gdp.htm[xliv]	GDP per capita in US$	UK level information
Central Government expenditure on transport	https://www.ukpublicspending.co.uk/spending_chart_1980_2020UKb_17c1li111lcn_60t[xlv]	£ Bn	UK level information
Police officer strength	http://researchbriefings.files.parliament.uk/documents/SN00634/SN00634.pdf	Persons	England and Wales data, UK data not available for period 1980 – 2020. No counts of traffic officers available. Data assumed to be proxy variable for UK police strength
Annual vehicle registrations	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794450/veh0153.ods	Million vehicles	GB data. No UK data available for period 1980 – 2020. GB data assumed to be proxy for UK annual registrations
Percentage of car population that was produced after 1996	Derived from annual vehicle registrations	%	2 new vehicle safety regulation came into force in 1996 covering front and side impacts.

Data	Source	Unit	Notes
Total registered vehicles	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794455/veh0103.ods	Million vehicles	GB data. No UK data available for period 1980 – 2020. GB data assumed to be proxy for UK annual registrations
Year since start of each road safety strategy period	Derived	Years from 0	Introduced as dummy variable representing underlying, unobserved trends

The data was selected to provide a set of indicators that could relate to the principal casualty reduction interventions identified in the safe system approach to road safety management:

- Road users
- Infrastructure
- Vehicles

It was not possible to identify a suitable indicator to represent post-crash care that had a complete time history available for the analysis. Other societal factors such as unemployment and ambulance response times may have been influential, but no datasets were available that covered the 40 year period of the analysis without change.

The factors were evaluated for each period of road safety strategy and the preceding period in order to identify the impact of these wider societal factors. The best fit model was identified for each period by removal of non-significant factors and the results are shown in Table 18 below for the fatality and KSI casualty rates during each phase of road safety strategy.

Table 18: Effect of societal parameters on fatality rate

Model 1 – all road safety strategies – 1980 – 2018

			Unstandardized Coefficients					
Fatality rate - dependent	Model years	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin-Watson model fit
Independent variable	1980 – 2018	0.367 (S.E. 0.17)						1.860
Strategy 1987-2000			-0.457	0.309	-0.068	-1.481	0.149	
Strategy 2000-2010			-0.187	0.316	-0.029	-0.592	0.558	
Strategy 2011 - 2018			0.784	0.490	0.099	1.601	0.120	
GDP per capita			2.616	1.010	0.891	2.590	0.015	
Total number of Police officers			-6.106	1.858	-0.146	-3.286	0.003	
% of car population produced after 1996			0.031	0.010	0.414	3.302	0.002	
Year from 1980			-0.661	0.091	-2.207	-7.286	0.000	
Constant β_0			18.158	2.697		6.733	0.000	

Model 2 – 1987 road safety strategy and preceding period

			Unstandardized Coefficients					
Independent variable	Model years	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin-Watson model fit

	1980 – 1999	-0.047 (S.E. 0.288)						1.855
Strategy 1987-1999			-0.992	0.557	-0.161	-1.779	0.101	
% of population aged 65+			-3.848	0.916	-0.445	-4.201	0.001	
Central Gov expenditure on transport			0.288	0.097	0.129	2.979	0.012	
Total number of Police officers			-28.101	4.858	-0.430	-5.784	0.000	
% of car population produced after 1996			-0.113	0.017	-0.297	-6.716	0.000	
Total annual vehicle registrations			2.065	0.511	0.178	4.042	0.002	
Constant β_0			96.919	11.798		8.215	0.000	

Model 3 – 2000 road safety strategy and preceding period

			Unstandardized Coefficients					
Independent variable	Model years	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin-Watson model fit
	1987 - 2010	0.507 (S.E. 0.203)						1.671
GDP per capita			-4.625	0.633	-1.862	-7.308	0.000	
% of car population produced after 1996			0.039	0.013	0.841	3.082	0.006	
Total annual vehicle registrations			0.955	0.354	0.228	2.702	0.015	
Strategy 2000 - 2010			0.297	0.441	0.086	0.673	0.510	
Constant β_0			13.030	1.486		8.771	0.000	

Model 4 – 2011 road safety strategy and preceding period

			Unstandardized Coefficients					
Independent variable	Model years	Autocorrelation coefficient	β_1	Std. Error	β_1 (standardised)	t	Sig	Durbin-Watson model fit
	2000 - 2018	-0.143 (S.E. 0.286)						1.876
Strategy 2011 - 2018			1.190	0.253	0.583	4.704	0.001	
% of population aged 65+			-2.201	0.333	-2.079	-6.611	0.000	
GDP per capita			0.718	0.336	0.413	2.134	0.048	
Total annual vehicle registrations			0.421	0.193	0.125	2.189	0.049	
Total number of Police officers			-7.079	1.184	-0.561	-5.981	0.000	
Constant β_0			45.368	6.149		7.378	0.000	

Table 18 shows that all four of the models showed a good fit to the data. Factors that were not statistically significant have been removed to enable the models to be as simple as possible.

The three road safety strategies were included together in model 1, which covered the period 1980 to 2018. In this time factors that exhibited small changes year on year were predominant in explaining the long-term trend in fatality rate reduction. The strategies themselves did not make a significant contribution in comparison. Factors that reduced fatality rate were the total number of police officers, which had a large impact, and the dummy variable year since 1980 which represented other

unobserved factors. Increases in GDP per capita were associated with large increases in fatality rate while the car population produced after 1996, had a marginal impact.

Model 2 covers the period of the 1987 road safety strategy and the immediate seven years preceding. The strategy did not make a significant contribution to reductions in fatality rate in comparison with other factors. The total number of police officers, cars produced after 1996 and the population over 64 were all factors that were associated with decreases in the rate. Central government expenditure on transport and annual vehicle registrations both were associated with increases in fatality rate.

Model 3 represented the years between 1987 and 2010 covering the period of the 2000 road safety strategy. As a factor the strategy was not significantly associated with changes in fatality rate however cars produced after 1996 and total annual registrations both were associated with increases in fatality rate. Increases in GDP were associated with decreases in fatality rates.

Model 4 shows the significant factors associated with fatality rates for the period 2000 to 2018, covering the road safety strategy published in 2011. Factors associated with reductions in fatality rate were the total number of police officers and the population aged 65 and over. Factors associated with increases in fatality rate were the road safety strategy, GDP and total vehicle registrations.

These factors are summarised in Figure 18 below where the impact of each safety strategy is shown, regardless of statistical significance, together with other factors found to be significant at the 5% level.

Table 19: Summary of factors in time series regression model of fatality rate

Period	Factors	Significance	Impact on fatalities
1987 - 1999	Strategy 1987-1999	0.101	Decreasing
	% of population aged 65+	0.001	Decreasing
	Central Gov expenditure on transport	0.012	Increasing
	Total number of Police officers	0.000	Decreasing
	% of car population produced after 1996	0.000	Decreasing
	Total annual vehicle registrations	0.002	Increasing
2000 - 2010	Strategy 2000 - 2010	0.51	Increasing
	GDP per capita	0.000	Decreasing
	% of car population produced after 1996	0.006	Increasing
	Total annual vehicle registrations	0.015	Increasing
2011 - 2018	Strategy 2011 - 2018	0.001	Increasing
	% of population aged 65+	0.000	Decreasing
	GDP per capita	0.048	Increasing
	Total annual vehicle registrations	0.049	Increasing
	Total number of Police officers	0.000	Decreasing

While it is possible to speculate on causal relationships between the factors and changes to fatality rate a further analysis is beyond the scope of this study.

14 Annex 3 – Indicators used to monitor road safety performance

	AUS	BE	BG	CAN	CZ	DK	EE	FR	FI	EL	IT	LV	LT	LU	MT	NL	NO	PL	PT	RO	SK	SL	ES	SE	CH	Total
FINAL OUTCOME INDICATORS																										
Total deaths																										
Total fatalities	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	25
Fatalities per billion vehicle km				x											x											2
Number of road accidents resulting in fatalities															x											1
Number of fatalities per 10 000 licenced vehicles															x											1
Number of fatalities per 1,000,000 people															x											1
Fatalities of subgroups	x																									1
Deaths from crashes involving a person aged 17-25	x					x																				2
Deaths from crashes involving a person aged 65+	x																									1
National indicators calculated for geographical regions								x																		1
Vehicle type																										
Deaths involving single vehicles	x				x	x																				3
Deaths involving heavy vehicles	x																									1
Cyclist fatalities	x					x																				2
Pedestrian fatalities	x					x																				2
Motorcyclist fatalities	x					x																				2

	AUS	BE	BG	CAN	CZ	DK	EE	FR	FI	EL	IT	LV	LT	LU	MT	NL	NO	PL	PT	RO	SK	SL	ES	SE	CH	Total
Fatalities involving specific vehicle types	x																									1
Causation factors																										
Fatal crashes involving driver with blood alcohol level above legal limit	x					x																				2
Vehicle occupants killed who were not wearing a seatbelt	x																									1
Fatal crashes involving an unlicensed driver	x																									1
Deaths of drivers with illegal drugs in system	x																									1
Road user groups																										
Deaths of drivers aged 17-25	x																									1
Deaths of drivers aged 65+	x																									1
Infrastructure																										
Deaths on metropolitan roads	x																									1
Deaths on regional roads	x																									1
Deaths on remote roads	x																									1
Deaths from crashes at intersections	x																									1
Deaths from crashes at intersections on rural roads						x																				1
Deaths from head on crashes	x					x																				2
Sub targets for right of way collisions					x																					1

	AUS	BE	BG	CAN	CZ	DK	EE	FR	FI	EL	IT	LV	LT	LU	MT	NL	NO	PL	PT	RO	SK	SL	ES	SE	CH	Total
Sub targets for overtaking collisions					x																					1
Fatalities by Road Type	x																									1
OUTCOME MEASURES																										0
Number speed tickets per 1000 population		x	x			x	x	x	x		x	x	x	x		x	x	x	x	x	x	x	x		x	19
Number of alcohol tests/1000 population							x	x	x	x	x		x				x	x	x			x	x			11
SAFETY PERFORMANCE INDICATORS																										
SPIs - fleet																										
Average age of vehicle fleet	x																									1
Average age of passenger vehicles	x																									1
Percentage of new light vehicles sold with a 5-star rating	x																							x		2
Percentage of new vehicles sold with Autonomous Emergency Braking (AEB)	x																									1
Percentage of safe motorcycles (ABS)																								x		1
SPIs - speed																										
Proportion of trips exceeding the speed limit						x									x								x			3
Proportion of drivers exceeding speed limit by at least 10km/h									x																	1

	AUS	BE	BG	CAN	CZ	DK	EE	FR	FI	EL	IT	LV	LT	LU	MT	NL	NO	PL	PT	RO	SK	SL	ES	SE	CH	Total
Average driving speeds, in 80 kph and 100 kph speed limit zones									x																	1
Share of traffic volume on roads with speed limit above 80km/h and median barriers																								x		1
Percentage of speed offenders per road type		x				x			x			x	x			x	x	x	x			x	x		x	12
Share of traffic volume within speed limits, national roads																								x		1
Share of traffic volume within speed limits, municipal roads																								x		1
Mean speed per road type		x					x	x	x			x	x			x	x	x	x		x	x	x		x	14
Percentage tested over the speed limit		x																								1
SPIs - risk factors																										
Proportion of adult cyclists wearing helmets						x																				1
Proportion of cyclists wearing helmets																								x		1
Proportion of moped drivers wearing helmets																								x		1
Proportion of motorcyclists wearing helmets															x											1
Drivers (and motorcyclists) with blood alcohol level above legal maximum	x																						x			2
% tested over the alcohol limit							x	x	x	x	x		x				x	x	x			x	x			11

	AUS	BE	BG	CAN	CZ	DK	EE	FR	FI	EL	IT	LV	LT	LU	MT	NL	NO	PL	PT	RO	SK	SL	ES	SE	CH	Total
Drivers (and motorcyclists) with blood alcohol level below legal maximum																								x		1
Proportion of drivers who admit to engaging in distracting actions while driving						x																				1
Proportions of drivers who wear seat belts						x									x								x			3
Proportion of driver or front seat passengers wearing seat belts									x						x								x	x		4
Proportion of rear passengers wearing seatbelts															x								x			2
Child restraint compliance															x											1
SPIs- infrastructure																										
Share of safe pedestrian, cycle and moped crossings on municipal roads																								x		1
Share of municipalities with good quality maintenance of pedestrian and cycle paths																								x		1
Total	23	4	1	0	3	13	4	4	8	2	3	3	5	1	6	3	5	5	5	1	2	5	10	11	3	130

15 Annex 4 - Safety Performance indicators - examples

Table 20: Recommended SPIs for adoption by EU Member States[xlvi]

	Indicator	**Definition**
1	Speed	Percentage of vehicles travelling within the speed limit
2	Safety belt	Percentage of vehicle occupants using the safety belt or child restraint system correctly
3	Protective equipment	Percentage of riders of powered two wheelers and bicycles wearing a protective helmet
4	Alcohol	Percentage of drivers driving within the legal limit for blood alcohol content (BAC)
5	Distraction	Percentage of drivers NOT using a handheld mobile device
6	Vehicle safety	Percentage of new passenger cars with a EuroNCAP safety rating equal or above a predefined threshold. *
7	Infrastructure	Percentage of distance driven over roads with a safety rating above an agreed threshold*
8	Post-crash care	Time elapsed in minutes and seconds between the emergency call following a collision resulting in personal injury and the arrival at the scene of the collision of the emergency services

*Complementary definitions are foreseen for this KPI

Figure 21: UK Parliamentary Advisory Council for Transport Safety PACTS recommendations

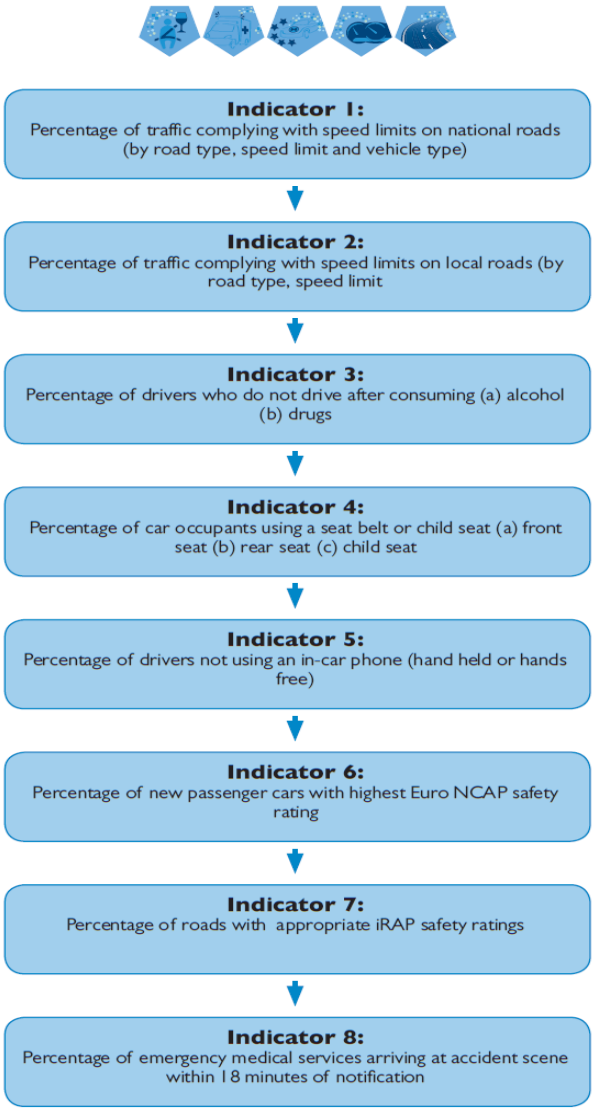

Table 21: Norwegian road safety strategy 2018 - 2021 – indicators and targets[xlviii]

Speed (section 4.1)	Percentage of vehicles travelling in excess of the speed limit	59,9 % (2017)	70 % (2022)
Intoxication (section 4.2)	Percentage of motor vehicle traffic involving intoxicated drivers with a blood alcohol content of 0.02%.	0,2 % (2016/2017)	0,1 % (2026)
	Percentage of motor vehicle traffic involving intoxicated drivers under the influence of drugs and over the threshold for criminal punishment.	0,6 % (2016/2017)	0,4 % (2026)
Seat belts/securing of children in the car (section 4.3)	Percentage of drivers and front-seat passengers wearing seat belts in private cars	97,2 % (2017)	98 % (2022)
	Percentage of children aged 1–3 years secured in rear-facing car seats	63 % (2017)	75 % (2022)
	Percentage of drivers of heavy vehicles wearing seat belts	84,3 % (2017)	95 % (2022)
Children (0–14 years) (section 5.1)	Number of children (0–14 years) killed in the road system.	4 (2017)	0 (at least one per year for 2018–2021)
Young people and younger drivers (section 5.2)	Risk of being killed or seriously injured for car drivers aged 18–19, per kilometre driven		- 30 % [A]
Older road users and road users with disabilities (section 5.3)	Risk of being killed or seriously injured for car drivers aged 75+ years, per kilometre driven		- 30 % [A]
	Risk of being killed or seriously injured in a traffic accident for pedestrians aged 75+ years, per kilometre walked		- 30 % [A]
Pedestrians and cyclists (section 6.1)	Number of kilometres of national roads and county roads adapted for pedestrians and cyclists	Total for the plan period: 165 km of national roads (2018–2021) B 230 km of county roads (2018–2021)	
	Percentage of cyclists wearing bicycle helmets	58,8 % (2017)	70 % (2022)
	Number of pedestrians using reflectors on lighted roads in the dark	40 % (2017)	50 % (2022)
Motorcycles and mopeds (section 6.2)	Risk of being killed or seriously injured for motorcycle and moped drivers per kilometre driven		- 30 % [A]
Transportation involving heavy vehicles (section 6.3)	Percentage of heavy vehicles with a maximum authorised mass of over 7,500 kg that pass the periodic roadworthiness test without serious remarks	23,2 % (2017)	30 % (2022)
Head-on collisions and Run-off-the-road accidents (section 7.1)	Percentage of motor vehicle traffic on national roads with speed limits of 70 km/h or higher that takes place on roads with median barriers	49,3 % as of 1 Jan 2018	54,1 % as of 1 Jan 2022
	Number of kilometres of national road with speed limits of 70 km/h or higher that have been assessed, and that meet the minimum standards set out in the NTP to prevent serious run-off-the-road accidents		1500 km (to undergo improvement works in 2018–2023) [C]
Vehicle technology (section 8.2)	Percentage of motor vehicle traffic involving cars with autonomous emergency braking (AEB)	14,4 % [D] (2017)	25 % (2022)
	Percentage of motor vehicle traffic involving cars with lane departure warning	39,2 % [D] (2017)	52 % (2022)
	Percentage of motor vehicle traffic involving cars with autonomous emergency braking to prevent collisions with pedestrians and cyclists (pedestrian AEB)	14,4 % [D] (2017)	25 % (2022)
Road safety work in county administrations and municipalities (section 9.1)	Number of municipalities approved as Road safe municipalities	62 [E] as of 1 Jan 2018	125 as of 1 Jan 2022

Table 22: Swedish road safety strategy 2019 - 2022– indicators and targets[xlix]

Indicator	Starting point	2018	2020 target	Trend
Share of traffic volume within speed limits, national road network	43 %	45 %	80 %	**Not in line with the required trend**
Share of traffic volume within speed limits, municipal road net- work (starting year 2012)	64 %	66 %	80 %	**Not in line with the required trend**
Share of traffic volume with sober drivers	99,71 %	99,73 %	99,90 %	**Not in line with the required trend**
Seat belt wearers in the front seat of passenger cars, share of total	96 %	99 %	99 %	**In line with the required trend**
Share of cyclists wearing a helmet	27 %	42 %	70 %	**Not in line with the required trend**
Share of moped riders using a helmet correctly	96 %	93 %	99 %	**In line with the required trend**
Share of traffic volume with the highest Euro NCAP score	20 %	76 %	80 %	**In line with the required trend**
Correct use of motor- cycles	-	-	-	**Not measured yet, no target set**
Share of traffic volume on roads equipped with speed limit above 80 km/h and median barriers and with speed limits above 80 km/h, national road networks	50 %	76 %	90 %	**Not in line with the required trend**
Share of safe pedestrian, cycle and moped passages	19 %	27 %	35 %	**Not in line with the required trend**
Share of municipalities with good-quality operation and maintenance of pedestrian and cycle paths	18 %	36 %	70 %	**Not in line with the required trend**
Systematic road safety work in line with ISO 39001	-	-	-	Not measured yet, no target set
Number of fatalities on the roads	440	324	220	**Not in line with the required trend**
Number of seriously injured on the roads	5 400	4200	4 100	**In line with the required trend**

It can be seen from the lists of SPIs adopted in Sweden and Norway together with the recommended practice at EU level that the specifications of the SPIs may vary but there are common themes.

Table 23: European Road Safety Observatory - Recommended SPI domains for data collection

Domain	Indicator	Priority I	Priority II	Priority III
Seatbelts and child restraints	Daytime wearing rate of seatbelts (passenger cars) on front seats	X		
	Daytime wearing rate of seatbelts (passenger cars) on rear seats	X		
	Daytime use of child restraint systems (<14y) in passenger cars	X		
Helmets for PTW riders and cyclists	Daytime use rates of motorcycle helmets	X		
	Daytime use rates of moped helmets	X		
	Daytime use of cycle helmets		X	
Driving speeds	Motorways with dual carriageway and median separation		X	
	Single carriageway rural roads		X	
	Single carriageway urban distributor roads		X	
Driving under the influence: alcohol and drugs	Fatalities resulting from crashes involving (at least) one driver or rider under the influence of alcohol (above the legal limit)	X		
	Fatalities resulting from crashes involving (at least) one driver or rider impaired by psychoactive substances other than alcohol (national offence impairment level)		X	
	Number of alcohol roadside checks by police per population	X		
Use of handheld cell phone	Proportion of passenger car drivers using a handheld cell phone (roadside survey)	x		
Infrastructure	The proportion of travel on new rural roads (non-motorways) that have a star-rating (Road Protection Score) of 3 or better		x	
	The proportion of travel on existing rural roads (non-motorways) that have a star-rating (Road Protection Score) of 3 or better			x
Vehicle	Average EuroNCAP occupant protection score of new passenger cars (cars sold in respective years)		x	
Post-Impact care	Composite indicator of 14 indicators in the field of a) Speed and quality of initial treatment by emergency medical services, and b) Quality of further medical treatment			x

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