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A Common Methodology for the Collection of Key Performance Indicators for Road Safety in the EU

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Abstract

The European Commission has put forward a new approach to EU road safety policy for the decade 2021-2030, highlighting also the need of setting new interim targets and establishing a range of key performance indicators (KPIs) for road safety at European level, which are directly related to the prevention of road accident fatalities and serious injuries. To measure progress and better understand the different issues affecting overall safety performance, a set of KPIs has been defined related to infrastructure safety, vehicle safety, safe road use including speed, alcohol, distraction and the use of protective equipment, and emergency response. The objective of this research is to provide an overview of a common methodology for the collection of the KPIs in the EU, present the principal guidelines for the data collection and the minimum expected results which will lead to the estimation of reliable and comparable KPIs at EU level.

Keywords: *Key Performance Indicators, road safety, European Union*

Περίληψη

Η Ευρωπαϊκή Επιτροπή έχει προτείνει μια νέα προσέγγιση στην πολιτική οδικής ασφάλειας της Ευρωπαϊκής Ένωσης για τη δεκαετία 2021-2030, τονίζοντας την ανάγκη θέσπισης νέων προσωρινών στόχων και καθιέρωσης μιας σειράς βασικών δεικτών επιδόσης (KPIs) για την οδική ασφάλεια σε ευρωπαϊκό επίπεδο, οι οποίοι σχετίζονται άμεσα με την πρόληψη θανάτων και σοβαρών τραυματισμών σε οδικά ατυχήματα. Για την παρακολούθηση της προόδου και την καλύτερη κατανόηση των διαφορετικών ζητημάτων που επηρεάζουν τη συνολική επίδοση, έχει οριστεί ένα σύνολο δεικτών που σχετίζονται με την ασφάλεια της υποδομής, των οχημάτων, την ασφαλή χρήση της οδού (ταχύτητα, αλκοόλ, απόσπαση της προσοχής και χρήση προστατευτικού εξοπλισμού) και της αντιμετώπισης έκτακτης ανάγκης. Ο στόχος αυτής της έρευνας είναι να παρουσίασει μια κοινή μεθοδολογία για τη συλλογή των KPIs στην Ε.Ε., να παρουσιάσει τις κύριες οδηγίες για τη συλλογή των δεδομένων και τα ελάχιστα αναμενόμενα αποτελέσματα που θα οδηγήσουν στην εκτίμηση αξιόπιστων και συγκρίσιμων KPIs στην Ε.Ε.

Λέξεις κλειδιά: Βασικοί Δείκτες Επίδοσης, οδική ασφάλεια, Ευρωπαϊκή Ένωση

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1. Introduction

Road crashes are one of the leading causes of death worldwide, especially among young people aged between 15 and 29 years old. Road traffic injuries claim more than 1,35 million lives each year and up to 50 million injuries (WHO, 2018), having a huge impact on public health and development. Compared to the global situation, Europe is showing a relatively better performance, thanks to targeted road safety policies implemented at European Union (EU), national and regional level over the last years. In 2020, EU recorded 42 road fatalities per million population, while the world average lies at more than 180, remaining, thus, the continent with the safest roads (EC, 2021).

The European Commission has committed to improve the safety of the European road network. On that purpose, the EC has adopted a Road Safety Programme which aims to halve the number of road deaths by 2020, compared to the 2010 level. This target followed an earlier target set in 2001 to cut road fatalities by 50% by 2010, which was almost achieved (ETSC, 2016). In 2020, in the EU, an estimated 18.800 people were killed in road crashes, recording an unprecedented decrease of 17% compared to the previous year. However, over the decade between 2010 and 2020, the number of road deaths were reduced by 36%, with the EU not reaching the respective target set for that decade (EC, 2021).

It is essential, thus, that road crashes are investigated and continuously monitored, allowing for a better understanding of road fatalities characteristics and the implementation of the appropriate accident mitigation measures. The European Commission has put forward a new approach to EU road safety policy for the decade 2021-2030, stressing the importance of a Safe System approach and highlighting the need of setting new interim targets and establishing a range of Key Performance Indicators (KPIs) for road safety at European level, which are directly related to the prevention of road accident fatalities and serious injuries.

Within this context, the EC funded project Baseline aims to assist EU Member States' authorities in the collection and harmonised reporting of the road safety KPIs and to contribute to building the capacity of those Member States which have not yet collected the relevant data for the KPIs. This project will be used to set European targets and goals for the future based on the KPIs. The objective of this research is to present the common methodological framework for collecting, processing and analyzing data for the estimation of comparable KPIs on:

- Speeding
- Use of safety belts and child restraint systems
- Helmet wearing
- Driving under the influence of alcohol
- Distraction
- Vehicle safety
- Infrastructure
- Post-crash care

The methodology developed for the collection of the KPIs, the principal guidelines for the data collection and the specifications for the minimum expected results should lead to the estimation of reliable and comparable KPIs in the EU. Starting from existing data on the aforementioned KPIs, existing practices and methodologies of data collection and process were explored, which

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alongside with international guidelines and methodologies available in the literature, were put into a proposal for a common framework to be used in the EU countries. More precisely, methodological guidelines for each KPI have been developed, including requirements for on-road observational studies, i.e. population, sampling, measurement instruments, stratification and subpopulations, as well as weighting and statistical analysis of the results.

The common methodological framework will allow the collection of representative and comparable KPIs among the EU countries, which will constitute the basis for setting targets for the KPIs and monitoring and evaluating progress in road safety at national and EU level over the decade 2021-2030.

2. Methodology

Road safety KPIs are an integral part of the 'Safe System' approach to road safety. Several Member States already collect indicators for their national policies, in order to measure progress and assess the effectiveness of road safety initiatives. Such indicators contribute to the understanding of the different issues that influence overall road safety performances and they help to underpin road safety policies.

For the purposes of the project, a survey among the Member States was conducted, which collected information on existing data collection methods for the estimation of KPIs as well as on authorities' needs for methodological support. The results of this survey, alongside with international guidelines and methodologies available in the literature led to the preparation of the methodological guidelines for each KPI for the Member States.

For the development of the final methodological guidelines, KPI Expert Groups (KEG) and a Technical Committee were established. More precisely, each KEG consists of 3 to 6 experts and its role is to prepare the methodological guidelines for the Member States and give advice to Member States on scientific, technical and practical issues that may arise in relation to the design and implementation of the data collection processes. On the other hand, the Technical Committee has an overall supervision of the work done within this project and coordinates the work of the different KEGs in order to ensure consistency in the development of the methodological guidelines and guidance to participating Member States.

The methodological guidelines for each KPI includes recommendations concerning the data collection (sample size, observation locations, observation methods, use of existing data sources, etc.), as well as the statistical analysis of the data for the calculation of the KPIs (data processing, weighting, aggregation, types of indicators, etc.). It is noted that the definitions and the minimum data requirements set by the EC for the calculation of the KPIs, as described in the Commission Staff Working Document SWD (2019) 283 have been taken as basis for the development of the methodological guidelines. In brief, the KPIs proposed by the EC and the respective definitions are shown in Table 1.

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Table 1. EU KPI definitions (EC, 2019)

KPI area	KPI definition
Speed	Percentage of vehicles travelling within the speed limit
Safety belt	Percentage of vehicle occupants using the safety belt or child restraint system correctly
Protective equipment	Percentage of riders of PTWs and bicycles wearing a protective helmet
Alcohol	Percentage of drivers driving within the legal limit for blood alcohol content (BAC)
Distraction	Percentage of drivers not using a handheld mobile device
Vehicle Safety	Percentage of passenger cars with a Euro NCAP safety rating equal or above a threshold
Infrastructure	Percentage of distance driven over roads with a rating above an agreed threshold
Post-crash care	Time elapsed between the emergency call following a collision resulting in personal injury and the arrival at the scene of the collision of the emergency services

3. Data Collection Framework

3.1 Speeding

The KPI for speeding (Teuchies et al., 2021) is defined as the *"percentage of vehicles travelling within the speed limit"*. This is operationalized by looking at the percentage of vehicles that remains below the speeding limit. Additional complementary KPIs are the speed below which 85% of drivers are driving (V85) and the average speed. A wealth of automatized collection machinery is available, from inductive loop detectors to – mobile or stationary – radar sensors and video-based software tools. Speeds can also be measured by manual observation by measuring devices (radars and handheld laser devices). The scope of the guidelines developed within this project is limited to devices that measure instantaneous speed, or spot speed at a particular location.

The minimal requirement for the KPI speed is to look at free flowing traffic. This means traffic conditions in which drivers can freely choose the speed they drive and are not restricted by traffic jams, infrastructure (e.g. speed bumps) or road works for instance. The measurements should also represent driving under normal conditions and should not be influenced, for instance, by adverse weather. The selection of the locations should be as random as possible with the objective of ensuring a representative sample for the national road network.

Temporal variations such as weekends may be considered, as well as the difference in speed levels between day and night. Comparisons between day and night are especially recommended due to the difference in traffic conditions and in the composition of the population of drivers between the two periods. The results should be shown separately for day and night and

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weekdays and weekend days. It is also advisable to concentrate measurements on late spring and early autumn.

The national KPIs on speed are expected to be estimated separately according to the following minimally required parameters:

- Vehicle type (personal cars)
- Road type (motorways, rural roads, urban roads)
- Time period (daytime on weekdays)

3.2 Use of safety belts and child restraint systems

The KPI for safety belts and child restraint systems (CRS) (Temmerman et al., 2021) is defined as *"the percentage of vehicle occupants using the safety belt or CRS correctly"*. The theoretical population refers to the total of all trips over the national territory. Road side surveys should provide a representative sample of all traffic in the country considered.

Visual observations performed by trained observers is the most common method used for recording seat belt and CRS use rates, with the observers being preferably placed along the roadside (or another convenient place). The use of cameras is also an alternative option to collect data on seat belt use. However, in that case, it should be ensured that the cameras will be installed on all types of road to avoid selection bias.

Estimating representative use rates for a country involves careful choice of number and spatial distribution of census points along different road categories in different regions, and the determination of proper sample sizes. Thus, the indicator should cover motorways, rural non-motorway roads and urban roads, with the results being presented separately for these three different road types.

Minimally, separate results for passenger car front occupants and passenger car rear occupants are expected. Data for occupants of light goods vehicles (LGV/vans) and heavy goods vehicles (HGV/lorries) are also recommended to be collected. During the measurements, target objects should be randomly selected from all the possible objects at the location where the observation is done. Furthermore, supplementary to the safety belt usage, additional occupant characteristics are recommended to be recorded for further analysis, i.e. gender (male/female) and age group (child: 0-18, young: 18-24, medium: 25-64, senior: 65+).

Data collection should be carried out during late spring or early autumn, on week days and weekends, which are expected to be observed and presented separately. Additionally, observations should cover the whole daytime and be conducted under reasonable good weather.

The national KPIs on seat belt and CRS use are expected to be estimated separately according to the following minimally required parameters:

- Road type (3 levels: motorways, rural roads, urban roads)
- Vehicle type (if applicable)
- Front vs rear occupant (in case of seat belt use in passenger car)
- Period (2 levels: week vs weekend)

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3.3 Helmet wearing

The KPI for helmet wearing (Moreau et al., 2021) is defined as *"the percentage of riders of powered two wheelers (PTW) and bicycles wearing a protective helmet"*. As data must be presented separately for PTW riders and cyclists, two KPI measurements should be conducted: one on helmet use among PTW riders and another one on helmet use among cyclists.

Like for the safety belt use measurements, direct observations performed by trained observers is the most appropriate method for recording helmet use rates, with the observers being preferably placed along the roadside (or another convenient place). If the use of cameras is considered, it should be ensured that they are not installed exclusively on one type of road to avoid selection bias.

In order to estimate representative use rates at national level, the number and spatial distribution of census points along different road categories in different regions should be carefully selected, and the proper sample sizes should be determined. Thus, the indicator on helmet use should cover motorways (only for motorcyclists), other rural roads, and urban roads.

The KPI on helmet use while riding on a PTW should include riders (also passengers) of motorcycles and mopeds; the KPI on helmet use while cycling should include riders (also passengers) of bicycles and power-assisted bicycles. Only for cyclists, where available, data for children (0-14 years old) are expected to be shown separately, to consider any legal requirements for helmet use. The age limit for the children however is recommended to be selected according to each national legislation, which mandates helmet use for children.

Data collection should be carried out during late spring or early autumn, on week days and weekends, which are expected to be observed and presented separately. Additionally, observations should cover the whole daytime and be conducted under reasonable good weather.

The national KPIs on helmet use (separately for PTWs and cyclists) are expected to be estimated separately according to the following minimally required parameters:

- Road type (3 levels: motorways (only for motorcycles), other rural roads, urban roads)
- Period (2 levels: week vs weekend)

3.4 Driving under the influence of alcohol

The KPI for driving under the influence (DUI) of alcohol (Boets et al., 2021b) is defined as the *"percentage of drivers driving within the legal limit for blood alcohol content (BAC)"*. For the data collection, three possible types of measurement method are considered:

- Random breath testing, i.e. roadside breath testing of randomly selected drivers
- Breath testing results from enforcement actions (even if not random)
- Self-reported behaviour through anonymous surveys

The EC expresses a clear preference for a KPI based on random breath testing, as this is generally considered to deliver an accurate picture of the situation. However, as random testing is not allowed in some Member States, breath testing results from enforcement actions is considered the second best option. If neither of these two options is feasible, data from self-reported behaviour based on anonymous surveys may also be accepted by the EC.

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Information of random breath testing is gathered by means of roadside surveys in cooperation with the police. During a roadside survey, drivers are randomly selected and stopped. The alcohol level of each of these stopped drivers is assessed by means of alcohol breath testing. Some basic information about the driver (e.g. age, gender) and the trip (e.g. length, motive) can optionally be observed or asked. Drivers need to be sampled randomly, meaning that the selection of drivers is irrespective of possible suspicion for DUI.

The minimum requirement for vehicle types is the inclusion of passenger cars. Goods vehicles, buses and motorcycles are optional supplementary vehicle categories, which would be useful for further analysis.

The roadside survey should provide a representative sample of all traffic in the study region. This covers in most countries three main road types: motorways, rural non-motorway roads (defined as roads outside built-up area) and urban roads (defined as roads inside built-up areas). The selection of locations should be as random as possible, covering the geographical area of the country. Separate results are also required for night hours and day time hours as well as for weekdays and weekend days. Data collection should also be carried out during late spring or early autumn.

The national KPIs on alcohol are expected to be estimated separately according to the following minimally required parameters:

- Road type (3 levels: motorways (only for motorcycles), rural roads, urban roads)
- Time Period (4 levels: night/day x week/weekend).

3.5 Distraction

The KPI for driver distraction (Boets et al., 2021a) is defined as the *"percentage of drivers not using a handheld mobile device"*. The most appropriate method for the data collection refers to observational roadside surveys, in which all (relevant) drivers or a random selection of (the relevant) drivers are observed. The use of a handheld device is directly observed and coded by trained observers, possibly together with some optional supplementary basic information about the driver (e.g. age, gender).

The minimum target groups are drivers of passenger cars, and possibly drivers of light goods vehicles and buses/coaches. Additional driver characteristics are suggested to be collected in order to allow further statistical analysis, i.e. driver gender and estimated driver age category (young (18-24 years), medium (25 to 65 years), older (> 65 years)).

Sampling of drivers (of the relevant vehicle categories) should be random. Target drivers should always be randomly selected from all the possible drivers at the location where the observation is done. At national level, three main road types should be covered: motorways, rural non-motorway roads and urban roads. The selection of locations should be as random as possible, covering the geographical area of the country.

Additionally, the measurements are recommended to be performed during daylight, with no differentiation regarding week-weekend being officially required. The minimal requirement is to plan the observation sessions at mixed time intervals during daylight hours of normal working days. Additionally, holiday periods (bank and school holidays) and hard winter conditions should be avoided though, as these disturb normal traffic patterns.

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The national KPIs on distraction are expected to be estimated separately according to the following minimally required parameters:

- Road type (3 levels: motorways, rural roads, urban roads)

3.6 Vehicle safety

The KPI for vehicle safety (Van den Berghe et al., 2021b) is defined as the *"percentage of new passenger cars with a Euro NCAP safety rating equal or above a predefined threshold"*. Euro NCAP ratings are the vehicle safety ratings assigned by Euro NCAP to new car models appearing on the European market, which are valid for six full years after the year of test. The overall rating is based on a 5 star scale, with 5 stars being the highest safety rating.

As to the safety threshold, two thresholds are suggested to be used:

- a 'soft' threshold, corresponding with a 4-star rating
- a 'strong' threshold corresponding with a 5-star rating.

For the calculation of the KPI data on the whole fleet of newly registered passenger cars should be collected from the national vehicle registries, while the principal data element for the calculation of the indicator is the distribution of the newly registered passenger cars by make and model.

Alternative indicators have also been considered for the EU Member States that are not able to calculate the Euro NCAP score for their fleet. These indicators are defined as "the average age of the total fleet of car passengers" and "the percentage of the passenger cars that are roadworthy". For these indicators, the whole fleet of passenger cars needs to be considered.

3.7 Infrastructure

The KPI for infrastructure (Van den Berghe et al., 2021) is defined as the *"percentage of the distance driven over roads with a safety rating above an agreed threshold"*. In absence of exposure data, the road length could be used as a proxy, with the indicator being defined as follows: "percentage of the road network length of roads with a safety rating above an agreed threshold". The threshold has not been agreed yet at European level, and different threshold will be explored in the project.

In order to be able to calculate the KPI, exposure data or the road length for the road segments in the network are needed, a safety rating method and a dichotomization of the safety rating, i.e. classifying road types into roads that are above the safety threshold.

A simplified version of the KPI , where no rating methodology is available is also suggested: "percentage of the distance driven over roads either with opposite traffic separation (by barrier or area) or with a speed limit equal to or lower than xx km/h in relation to total distance travelled" or "percentage of the road network length of roads either with opposite traffic separation (by barrier or area) or with a speed limit equal to or lower than xx km/h in relation to total distance travelled". The difference of these versions of the indicator with the prime indicator is that the type of safety rating is already given. The safety threshold is assumed to be achieved when either the road has opposite traffic separation, or has a speed limit equal or lower than a defined threshold.

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Three types of safety rating methods are proposed:

- infrastructure based methods: based on assessing the (geometric) characteristics of the roads and whether the examined road has particular structural safety components which make it safe for the type of traffic and the speed of the vehicles.
- crash based methods: based on the actual crash risk level for particular road segments or types of roads, which are determined through statistical analysis and modelling based on the number and severity of (injury) crashes occurring on these roads.
- a combination of the aforementioned methods.

3.8 Post-crash care

The KPI for post-crash care (Van den Berghe et al., 2021c) is defined as *"the time elapsed in minutes and seconds between the emergency call following a road crash resulting in personal injury and the arrival at the scene of the road crash of the emergency services (to the value of the 95th percentile)"*.

In principle the indicator should be representative of the whole Member State territory. On that purpose, the collection of all calls related to road traffic crashes from a central national database is preferred. If such a database is not available, a representative sample of responses to emergency calls in relation to road traffic crashes should be collected. In order to calculate the KPI on post-crash care, the identification of the time of the emergency call and of the time of arrival of the emergency service are needed.

The KPI is expected to be calculated for 2019 or the year with the latest available data. Additionally, a breakdown by road type (motorways, rural, urban roads) is also recommended.

4. Conclusions

Continuous and systematic monitoring of road safety performance will allow for a better understanding of accident causalities and the implementation of the proper measures and policies in order to prevent these casualties. To measure progress, the most basic and important indicators are the result indicators on deaths and serious injuries. However, in order to gain a much clearer understanding of the different issues that influence overall safety performance, the European Commission has elaborated a first set of KPIs, which refer to main road safety challenges to be tackled, namely: infrastructure safety, vehicle safety, safe road use including speed, alcohol, distraction and the use of protective equipment, and emergency response.

The aim of the KPIs is to monitor road safety progress and to be connected to the EU targets of the next decade. Thus, the collection of comparable KPIs among the European countries is needed. The development of the current methodology takes into account the best national practices observed in the EU and aims to provide insightful support to those Member States that have never collected such data again. The common methodology for the collection of KPIs includes guidelines on both data collection and their statistical analysis for the estimation of the indicators. The minimal data and parameter requirements are also defined in order to obtain a full set of comparable EU KPIs.

Concluding, the common framework will allow the collection of representative and comparable KPIs among the EU countries, which will constitute the basis for monitoring and evaluating the

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road safety progress at national and EU level over the decade 2021-2030, providing also useful support to decision makers working for the improvement of safety in the European road network.

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