Baseline

Methodological guidelines – KPI Distraction

Version 3.0, April 27, 2021

Baseline

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Any comments or feedback regarding these guidelines should be sent to baseline@vias.be .

Version history

Version	Date	Changes
1.0	December 15, 2020	First draft version - intended as a framework to discuss methodological issues in the Technical Committee
1.1	February 23rd 2021	Incorporation of feedback from the Technical Committee and KPI Expert Group (KEG) on Distraction. Adaptation of structure
1.2	March 3rd, 2021	Minor amendments. Used for discussion within KEG group meeting
1.3	March 11th, 2021	Draft incorporating all decisions from the Technical Committee and feedback from the European Commission.
2.0	March 17th, 2021	Draft for review by Member States
3.0	April 27th, 2021	Incorporation of feedback from Member States and final adjustments in line with other Methodological Guidelines

Contents

1 Introduction and aims

The Communication of the European Commission "Europe on the Move – Sustainable Mobility for Europe: safe, connected and clean" of the 13th May 2018 confirmed the EU's long-term goal of moving close to zero fatalities in road transport by 2050 and added that the same should be achieved for serious injuries. It also proposed new interim targets of reducing the number of road deaths by 50% between 2020 and 2030 as well as reducing the number of serious injuries by 50% in the same period. To measure progress, the most basic – and important – indicators are of course the result indicators on deaths and serious injuries.

In order to gain a much clearer understanding of the different issues that influence overall safety performance, the Commission has elaborated, in cooperation with Member State experts, a first set of key performance indicators (KPIs). The KPIs relate to main road safety challenges to be tackled, namely: (1) infrastructure safety, (2) vehicle safety, (3) safe road use including speed, alcohol, distraction and the use of protective equipment, and (4) emergency response. The aim of the KPIs is connected to EC target outcomes.

The aim of the BASELINE project, funded partially by the European Commission, is to assist participating Member States' authorities in the collection and harmonized reporting of these KPIs and to contribute to building the capacity of Member States which have not yet collected and calculated the relevant data for the KPIs. The outcomes of this project will be used to set future European targets and goals based on the KPIs.

The purpose of this document is to further describe the minimal methodological requirements to qualify for the BASELINE KPIs for driver distraction, defined as:

Percentage of drivers not using a handheld mobile device

The target audience of this document are the persons in the participating Member States that will collect and/or analyse the data to deliver the KPIs.

The minimal requirements set by the EC for this KPI are described in the Commission Staff Working Document SWD (2019) 283 (see annex 1: KPI 5 Distraction). In this guideline document these requirements are quantified and specified for each of the parameters, and this mainly based on expert consultation (BASELINE Key Expert Group Distraction) and the following references:

- FERSI guidelines: Vollrath, M., Schumacher, M., Boets, S., & Meesmann, U. (2019) Guidelines for assessing the prevalence of mobile phone use in traffic. FERSI technical paper. Retrieved from https://fersi.org/wp-content/uploads/2019/11/Guidelines-prevalence-mobile-phone-use.pdf (see Annex 3: overview of the FERSI recommendations)
- SafetyNet: Hakkert, A.S and V. Gitelman (Eds.) (2007) Road Safety Performance Indicators: Manual. Deliverable D3.8 of the EU FP6 project SafetyNet. Retrieved from: http://www.dacota-project.eu/Links/erso/safetynet/fixed/WP3/sn_wp3_d3p8_spi_manual.pdf

In addition to the specification of the **minimum requirements** (always marked bold) to deliver the main KPI and the disaggregated indicators, this document also includes recommendations for optional additional activities. Member States can decide whether to follow the minimum requirements only or to extend (part of) their methodology, depending on available means and their own research questions.

2 Scope

2.1 General principles

SWD allows "***direct observation*** *by trained observers on the roadside or from moving vehicles. Other alternatives could be used if available, e.g. automatic detection. To be decided by Member States.*"

The main method proposed is observational roadside studies, 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 objective of the roadside observation study is to estimate the percentage of drivers NOT using a handheld mobile device. The theoretical population refers to the total of all journeys (or at least from the vehicle types targeted) over the national territory. In other words, this reflects the total number of kilometres driven. Hence, the

percentage of drivers NOT using a handheld mobile device refers to the percentage of kilometres driven without using a handheld mobile device.

The basic aim is for all participating Member States to have comparable indicators for the minimum required stratifications. Optional disaggregated indicators will only be compared for countries that are able to deliver those.

Self-report methods (e.g. roadside interviews or self-report surveys) are outside the scope of this KPI.

2.2 Type of distraction to be observed

The KPI states *"handheld mobile device use"*. The use of 'device' instead of 'phone' makes this KPI futureproof. A mobile device can be defined as "a computer small enough to hold and operate in the hand" (e.g. https://en.wikipedia.org/wiki/Mobile_device), such as: mobile phones (e.g. smartphones), mobile computers (e.g. tablets), personal navigation devices, digital cameras.

Most Member States have a ban on mobile phone use while driving, while in some States this has meanwhile been extended to mobile electronic 'devices'. Participating Member States are expected to provide metadata on the applied regulations and procedures related to this.

As an absolute minimum, two clearly visible distraction categories, excluding each other, should be recorded in each observation:

- **Having a mobile device in the hand (driver is holding a mobile device in the hand, which can be held at the ear, at the steering wheel or anywhere else)**
- **Not having a mobile device in the hand (rest category).**

Although the KPI refers to 'use of a handheld mobile device', this categorization is based on what is visibly detectable during an on-road observation study. This allows a clear and uniform observation procedure, even though handheld mobile device use will be underestimated because drivers often hide their mobile device under the dashboard or on their laps.

Optionally, as a function of their own research questions, Member States can decide to collect additional information on different basic tasks related to using a mobile device in the hand (e.g. phoning or texting), and/or to distinguish mobile phones from other mobile electronic devices. This latter distinction can be especially interesting for Member States with legislation which so far refers to mobile phones only.

The following categories are based on FERSI (Vollrath et al., 2019) and can be used:

- Having a mobile phone in the hand:
  - Handheld phoning: the driver is visibly holding a mobile phone in the hand and is pressing it at his/her ear or is holding it in front of the mouth. He/she is either talking or listening.
  - Texting/keying numbers handheld (mobile phone): the driver is visibly holding a mobile phone in the hand and is operating it.
  - Handheld reading/watching without operating (mobile phone): the driver is visibly holding a mobile phone in the hand and is looking at the phone without operating or handling it.
- Having another mobile device in the hand:
  - Operating another mobile electronic device in the hand: the driver is operating an electronic device other than a mobile phone (e.g., tablet, navigation system) and is holding this device in the hand.
  - No mobile phone or device in the hand (rest category)

Optionally, even more distraction categories could be collected (see e.g. recommended categories by FERSI – Vollrath et al., 2019). When defining more (differentiated) distraction categories, it should always remain possible to derive the minimum distraction category for the KPI (handheld mobile device use vs. NO handheld mobile device use) from the data.

2.3 Vehicle types to be included

SWD requires the inclusion of "*Cars, light goods vehicles, and buses/coaches as a minimum. Other user types if possible (disaggregated by user type)*".

The target groups to include at a minimum are (see CARE definitions[1]):

- passenger cars
- light goods vehicles (LGV; often from companies)
- buses/coaches (including mini-buses and public transport buses).

The data collection should include a variable "vehicle type" with these three categories.

The **minimum requirement is to provide aggregated results for these three different vehicle types 'together'.** This means that the data from the three vehicles types can be combined to provide the KPI. No separate KPI per vehicle type is required. The further specified minimum sample sizes consider the three vehicle types 'together'.

Although providing disaggregated results is not requested, it is recommended to also provide differentiated results by vehicle type if the respective sample sizes are large enough to allow this (see Section 3.2).

The different vehicle types and their specific categorization should be clearly defined and illustrated for the observers (training) and in the methodological report: for example, some cars and vans share the same brand/model like Renault Kangoo (a passenger car is a vehicle with backseat windows and passenger seats; a van has no backseat windows and no rear passenger seats).

Heavy goods vehicles[2] (HGV) or trucks are not mentioned in the SWD. It is recommended however to include this vehicle type if there is a specific interest of a Member State in distraction in this vehicle type. Of course, this should be feasible (see Section 3) and a sufficiently large sample for this extra vehicle type should be reached to provide sufficiently accurate separate results (min. 2,000; see section 3.2).

2.4 Driver characteristics (optional)

Member States with an interest in additional information on risk factors or predictors of distraction while driving, are encouraged to optionally record some easily observable extra variables such as:

- gender of the driver
- estimated driver age category (e.g. Vollrath et al. (2019) FERSI recommendation: young (18-24 years), medium (25 to 65 years), older (> 65 years))
- private vs. professional vehicle or driver (e.g. taxi)
- presence of passengers (yes/no)

Such additional variables can provide valuable input for evidence-based and risk group-oriented countermeasures (e.g. education and awareness building activities such as campaigns).

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[1] CARE (2018) definitions:

- [Car or taxi] Motor vehicle with 3 or 4 wheels, mainly used to transport people, seating for no more than 9 occupants (including the driver). Motor vehicles with these characteristics used as taxis as well as motor caravans are also included.
- [*Light goods vehicle*] Goods vehicle under 3.5 tonnes maximum gross weight: Lorry: goods vehicle under 3,5t. Smaller motor vehicle used only for the transport of goods. *(= also van for transport of equipment by workers such as electricians, plumbers…)*
- [Bus/coach]. Bus: passenger-carrying vehicle, most commonly used for public transport, having more than 16 seats for passengers. Coach: passenger-carrying vehicle, having more than 16 seats for passengers. Most commonly used for interurban movements and touristic trips. To differentiate from other types of bus, a coach has a luggage hold separate from the passenger cabin.

[2] Based on CARE (2018) definition of heavy goods vehicle: Includes road tractors, goods vehicle over 3.5 tonnes maximum gross weight, and "goods vehicles". Road tractor: road motor vehicle designed, exclusively or primarily, to haul other road vehicles which are not power-driven (mainly semi-trailers). Goods vehicle over 3.5 tonnes mgw: larger motor vehicle used only for the transport of goods. Goods vehicle: motor vehicles used only for the transport of goods (irrespectively from vehicle weight). Includes road tractors and road tractors with semi-trailers. Type C driving licence required.

3 Measurement procedure

3.1 Sampling individuals

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. The easiest way to guarantee random sampling is that after finalisation of the coding of one observation, the first next passing target driver (on the specified road lane and direction) should be observed.

Most of the observed drivers will be car drivers as this is the most frequent vehicle type in motorized traffic. **While there are generally less light goods vehicles and buses/coaches, the observer should give no specific priority to them in the measurement.** Only if the first next passing vehicle in the observation lane is a LGV or a bus/coach this driver should be coded.

Observations should be made in flowing traffic only, so of drivers while driving, since distraction behaviour is different when stationary, e.g. waiting at traffic lights. **No observation should be made of stationary drivers** (see also Section 3.4).

3.2 Minimum total sample size

Defining a minimum required sample size is by definition arbitrary since it depends on the level of accuracy that is considered adequate. Assuming an overall prevalence percentage of 5% to 10 % for handheld mobile device use while driving, accuracy in the order of 5% ±1 to 10% ±1.3 for this KPI can be considered acceptable (see Table 1).

$$\mathrm{CI} = \text{prevalence} \pm z * \sqrt{\frac{prevalence\ (100\ -\ prevalence)}{n}}$$

Prevalence	Lower bound CI, n=2000	Upper bound CI, n=2000	Lower bound CI, n=500	Upper bound CI, n=500
5%	4.04%	5.96%	3.09%	6.91%
10%	8.69%	11.31%	7.37%	12.63%

Table 1: Assuming simple random sampling and depending on prevalence levels between 5% and 10% for handheld mobile device use, the 95% confidence intervals (CI) for n=2,000 and n=500 are estimated using the formula above (z value 1.960 for 95% CI): upper and lower bound of the CI for the point estimates.

A sample size of about 2,000 observations should therefore be sufficient to provide frequency estimations (percentages) of the order of 1-1.3% with a 95% confidence interval. **Thus, as an absolute minimum 2,000 observations overall** (for the three minimally required vehicle types together) **is required.** This minimum refers to valid datapoints in the study dataset in order to be considered for the national KPIs. No minimum sample size for the different vehicle types is defined because the minimum requested KPI is the aggregated result for the three types.

Member States aiming at having higher accuracy can calculate the required sample size to gather results with a specified accuracy level and confidence interval, using this formula: (FERSI - Vollrath et al., 2019)

When planning the study, the sample size required for the respective purpose should be considered. For example, to estimate the prevalence of texting on the mobile phone with a precision of 1% (width of 95% confidence interval) and it is assumed that the percentage lies around 5%, one can use the following formula to determine the required number of observations.

$$N_{required} = \frac{1.96^2 * \left(P * (100 - P)\right)}{Precision^2}$$

When using a P = 5% and a Precision of 1%, this gives:

$$N_{required} = \frac{1.96^2 * (5 * (100 - 5))}{1^2} = 1825$$

Accuracy for different subgroups or stratifications, such as the three road types, will by definition be lower. If higher accuracy levels are expected for particular strata (road type, regions) , it is strongly recommended to increase the total sample size. Ideally, a multiple of the minimum sample size can be obtained, which increases the accuracy of the estimates, and optionally can allow delivery of reliable estimates for separate categories of vehicle types or for further (crossed) stratifications (e.g. per road type x time period, per region).

Annex 2 gives an overview of the argumentation behind the minimum driver sample. If, optionally, Member States aim at having disaggregated results by vehicle type, then the minimum sample size of 2,000 drivers should be applied to each vehicle type.

If similar accuracy levels are expected for particular stratifications/subgroups, it is strongly recommended to increase the total sample size. Member States optionally willing to have reliable KPI estimates for different possible combinations of stratifications (e.g. road type x time period; region x road type; region x road type x time period) should have a design with minimum 500 observations for the different relevant crossed strata (e.g. 3 regions x 3 road types x 3 time periods = 27 strata x 500 observations = needed sample of 13,500 drivers).

3.3 Sample size per road type

On-road observation studies should provide a representative sample of all traffic in the considered study area. For distraction the **minimum stratification to take into account is road type**. This covers three main road types: **motorways**[3]**, rural non-motorway roads** (defined as roads outside built-up areas)**, and urban roads** (defined as roads inside built-up areas). **This is the minimum required categorization**.

If Member States historically use a different road categorization, an attempt should be made to infer the minimum required road types. The road types considered and any deviation from the minimum requirements should be explained in the methodology (general characteristics like traffic signs to define inside/outside built-up area, possible speed regimes and number of lanes…).

In order to ensure a minimum number of observations for each road type, even if this would imply disproportionate sampling, **at least 500 observations for each category of road type are required, thus:**

- **minimum 500 drivers on urban roads**
- **minimum 500 drivers on rural roads**
- **minimum 500 drivers on motorways** (this requirement does not apply to Member States with no motorways or where the network of motorways is very limited).

It should be noted that this leads to bigger error margins for the point estimate for each of these roads. Given an overall prevalence of distraction of 5% to 10% this would give the following 95% confidence intervals for this level of aggregation: 5% ±1.9 to 10% ±2.6 (see Table 1).

3.4 Sampling and selection of locations

The **selection of locations should be as random as possible,** covering the geographical area of the country. There are different options for random location selections, such as simple random and stratified random (e.g. random sampling in different regions). The basic process for the random selection of locations consists of three steps:

(1) Step 1: The required number of different locations (for the country or per region) is determined.

(2) Step 2: The number of locations is randomly selected on the map using the entire area under consideration (e.g. country or region), taking a sufficient geographical spread into account. The specific requirements for each location do not have to be taken into account at this point. This step is to ensure a reasonable geographical spread of the randomly selected locations.

(3) Step 3: The final locations that will be used for the observations are manually chosen in the area surrounding the locations randomly selected in the previous step. At this point, the final selection must be based on the

[3] Motorways are defined by CARE (2018) as: Public road with dual carriageways, and at least two lanes each way. Entrance and exit signposted. Road with grade separated interchanges. Road with a central barrier or central reservation. No crossing permitted. No stopping permitted unless in an emergency. Entry prohibited for pedestrians, animals, bicycles, mopeds, agricultural vehicles.

location requirements (different road types), inclusion/exclusion criteria (if applicable) and practical considerations. This final selection can be made using Google Street View. Care should be taken to ensure that the different road types are also sufficiently geographically spread.

A convenient way of selecting locations randomly (step 2) is to use a GIS system (e.g. cartographic software like ARCView/ARCGIS) as such software automatically selects location points within defined areas randomly (e.g. https://desktop.arcgis.com/en/arcmap/latest/extensions/geostatistical-analyst/an-introduction-to-sampling-monitoring-networks.htm). If Member States have no GIS software, step 2 can also be done manually using a national geographic map, e.g. Google Maps/Google Earth.

Since a random selection of locations will also include low volume roads, it is expected that several low volume locations will be available for each stratum. If however traffic flow is too low, it is also be acceptable not to include them. It is acceptable not to include locations with less than 10 relevant vehicles passing per hour.

Pragmatical considerations related to the locations should be taken into account: the observers should have a good view of the passing traffic while also ensuring that the observations can be conducted safely and inconspicuously (see also Sections 3.6.2 and 3.6.3).

Furthermore, typical criteria for observation studies on distraction are related to the free flow of the traffic, so ideally no locations should be chosen in front of traffic lights. Observation can take place near intersections but **only drivers who are driving should be observed, not drivers who are stationary**.

It is recommended to sample locations for the three road types proportionally to traffic volume on the road types (or proportionally to the kilometres driven on each road type in a country), assuming that each of the three road types represent a share of traffic volume above 20%, with this based on available national data (e.g. traffic/mobility data by road type from national traffic surveys). If traffic volume data is not available, or if the traffic volume share of a road type is less than 20%, then an **absolute minimum of 10 different locations per road type** should be selected in order to ensure representative results for the entire road network (see Annex 2 for the argumentation behind the minimum location sample of 10 locations per road type):

- **Minimum 10 locations on urban roads**
- **Minimum 10 locations on rural roads**
- **Minimum 10 locations (or sections) on motorways**

Taking into account the other criteria (Sections 3.2 and 3.3), this comes down to a mean minimum of 67 observations per location, if 30 locations are chosen. It is allowed to re-use the same sampling location for different times of day or days of week (different sessions).

When, optionally, stratification according to time period is used too, a minimum of 2 different locations for each combination of strata should be used (e.g. 3 road types x 3 time periods = 9 crossed strata).

For more information on random sampling of locations and for determination of the minimal sample size, reference can be made to the SafetyNet general recommendations for SPI (safety performance indicators): http://www.dacota-project.eu/Links/erso/safetynet/fixed/WP3/sn_wp3_d3p8_spi_manual.pdf

To summarize, the minimum required sample sizes to provide the KPIs are:

- **Minimum 2,000 observations in total (aggregated vehicle types)**
- **Minimum 500 observations per road type (3)**
- **Minimum 10 locations per road type (3) = min. 30 locations in total.**

3.5 Optional further stratifications

3.5.1 Stratification by time period

SWD only requires the observations "*during daylight*" and no differentiation regarding week-weekend is requested. The **minimum requirement is to plan the observation sessions at mixed time intervals during daylight hours in normal working days. The mix of possible moments should be balanced over the three road types (i.e. to have a similar variation of considered day hours for the three road types).**

Optionally, time period can also be considered as an additional stratification for Member States willing to have results for different relevant time periods. In such cases the FERSI recommendation of using three time periods (weekday peak, weekday off-peak and weekend day) can be considered, cf. FERSI (Vollrath et al., 2019):

> *"It is recommended that observations cover the whole daytime and different working days. This can be achieved by doing observations at least at two time intervals: peak hours (commuters) and off-peak hours and from Mondays to Saturdays to be able to differentiate between week-weekend. This allows to work with three time intervals: week-peak (e.g. 7-9, 16-18), week-off-peak (e.g. 10-15), weekend (e.g. 10-18).*
>
> *If different time intervals are selected, these should be randomly allocated to the different (stratified) locations within each location type selection (either one location is assigned a specific time interval, or different (time interval) sessions are organized at one location). It should be checked that the distribution of road types and time intervals is proportional to traffic volumes x time intervals OR that it's is balanced with a minimal number of sessions in each combination for proper data analysis (and application of weights afterwards).*
> *Observation sessions within a specific time interval should start and end within this time interval."*

If stratification according to different time periods is also aimed for, then the minimum of 500 observations and 10 locations should be used per time period also. To ensure a balanced sampling for road types and time periods, a minimum of 2 locations for each combination of road type and time period should be used.

3.5.2 Stratification by region

Disaggregation by region is not a requirement. Member States are free to choose supplementary stratifications according to country regions (e.g. NUTS 1 regions). In that case countries can consider collecting data from each region or from a representative selection of regions.

Member States aiming at having meaningful KPIs at the regional level, including road type differentiation per region, will need a multiplication of the required minimum location sample and driver sample. The minimum location and driver sample requirements are then required for each region surveyed (see Sections 3.2, 3.3 and 3.4).

3.6 Practical organisation of the observations

3.6.1 Fieldwork set-up and procedure

A uniform fieldwork procedure should be chosen. Member States can estimate how many sessions and observation hours will be needed in order to reach the required or aimed at driver sample size, taking also the minimum location requirements into account. **One observation session should last at least 30 minutes.** Ideally and for practical reasons however 1 hour or longer (e.g. up to 3h) sessions are recommended. Furthermore, different sessions can be spread over mixed hours (or, optionally, over different time periods) at one location (e.g. spreading and balancing time per location) or each location can be used for one session (i.e. balancing time over locations within road types; this is the minimum requirement). **When planning the fieldwork sessions, one should ensure a balanced combination of the 3 road types and the time periods considered**, to avoid a systematic sampling bias (e.g. all motorway sessions in the morning and all urban sessions in the afternoon).

Prerequisites for carrying out observations are generally: good enough weather conditions (no heavy rain, no storm, no snow), good visibility (no darkness, no fog), good road conditions (no ice), flowing traffic (no accident or construction site).

Observation of drivers in trucks may be more difficult than observation of car drivers due to their high seat position and windows, even as compared to bus/coach drivers which generally have more extended lower windows. For observing 'higher' positioned drivers, observers should have a high enough observation position or viewpoint. Suggestions are to use a safe and stable device to stand upon; taller observers will also have an advantage. When observations from a moving vehicle are used (e.g. on high speed roads, see Section 3.6.3) then ideally a vehicle with a higher seat position is used.

The **observations should be made by well-trained observers along the road or from moving vehicles**. As indicated by FERSI (Vollrath et al., 2019),

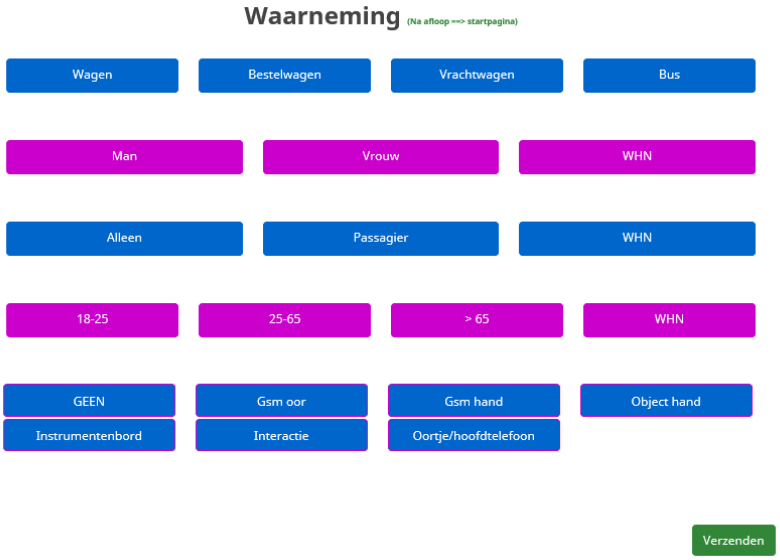
> *"…this requires a thorough training of the observers, ideally both theoretically (e.g. a briefing explaining aim, variables and definitions, coding tool, complete procedure) and practically (e.g. exercises on the road with a trainer), and ideally also including a performance test to ensure a high inter-rater reliability between the observers. This is ideally checked from time to time during the fieldwork in order to ensure a high data quality.*
>
> *Regarding the number of observers for one observation session, one well-trained observer can be used. This has the advantage of being unobtrusive and efficient. At very busy sections it may be advisable to have two*

observers, e.g. one doing the observation and telling the results to the second observer, who is recording them. However, when using a limited number of variables even single observers are well able to observe and record at the same time."

For the on-site coding, paper sheets or tablet computers/smartphones can be used. Using a tablet or smartphone can have some advantages (e.g. direct coding, real-time central data collection, automatic coding of meta-data like the exact location, date and time of each coding, which also could serve for quality assessment), but the tool should be tested beforehand (user friendliness, speed, correction possibilities…) and be evaluated to be better than paper coding. Some examples of existing programs are:

- FERSI (Vollrath et al., 2019): for Windows tablets, free and configurable software is provided by TU Braunschweig: www.tu-braunschweig.de/psychologie/verkehrspsychologie/software [05.08.2019]
- CDV mobile phone app created for certain road side surveys (*more info on this tool can be provided if requested*)
- Example tablet/smartphone app display (Belgian distraction roadside survey, 2020 – in Dutch):

Driver and main distraction categories:



3.6.2 Observations at urban and rural roads

Stationary and moving observations on low and high speed roads should always be carried out in accordance with the applicable (road) safety regulations.

Observations on urban and rural roads can be made from a **safe place along the road**.

It is recalled that observation can take place near intersections but **only drivers who are driving should be observed, not drivers who are stationary**. If the traffic flow is disturbed at a selected location (e.g. due to works or an accident), then the observer should choose a new location on the same lane or nearby (within the same road category). Furthermore, more complex traffic situations requiring the full driver's attention are also best avoided.

3.6.3 Observations on motorways

Observations on motorways (or high speed roads) are possible from locations along the motorway that are easily reachable for observers (e.g. on rest/parking areas) and where observers can stand behind a safety barrier to observe oncoming and passing vehicles on the motorway lanes. It is important that these locations allow observation of traffic travelling undisturbed (not therefore locations where drivers have to stop or pay special attention to circumstances). This observation location should at least be usable for observation of vehicles on the lane closest to the observer (right lane) and for vehicles driving generally slower (e.g. buses/coaches). Observing vehicles on the lanes further away or vehicles at high speed may be more difficult.

A complementary or alternative method on motorways is to make observations from a moving vehicle in real traffic, with a driver and an observer on the backseat, which allows observing overtaking and overtaken vehicles on different lanes and also observing vehicles riding at different (also high) speeds (e.g. Riguelle & Roynard, 2014).

Using this method, the geographical location is rather determined as a section (from location x to location y) than as one specific location on a certain motorway. These sections should reflect as far as possible the required min. 30 minutes duration of driving/observation. The lanes and speeds of the observation vehicle should be varied in a systematic way in order to carry out the observations in a representative way (e.g. 15 min. driving on the right lane at 90km/h and observing overtaking vehicles on the middle lane, then 15 min. driving on the middle lane at 120 km/h and observing overtaking and overtaken vehicles) within one observation session. In order to carry out the required traffic counts, the observer can stop at a safe location along the motorway section (e.g. behind a barrier overlooking the motorway at a rest/parking area).

The method of observation from moving vehicles (e.g. on the middle and left lanes) can be combined with stationary observation of vehicles on the right lane. Ideally, vehicles with a higher seat position should be used for a better view of the drivers. If this is not possible, observations from overpasses can also be considered, as long as these are not too high and provide a good viewpoint on the lanes; but a possible drawback is that observers in that position may be more noticeable by drivers which makes inconspicuous observation more difficult.

Camera observation may also be considered for safety reasons on higher speed roads, even though this method also presents some disadvantages (see Section 5).

3.6.4 Counting of traffic

Traffic volumes should be counted during each observation session, even when national traffic volume statistics are available. This information is needed for the calculation of the percentage of drivers not holding a mobile device for each observation session and for correct calculation of the confidence intervals (weighting).

Counting of traffic during a session is ideally done by counting all (including the observed) passing relevant vehicles (i.e. the types that are considered in the study; this can be combined for the three vehicle types but if separate KPIs per vehicle type are aimed at (optional), this should be done also separately per vehicle type), in the same lane(s) and in the same direction as the observation. In the ideal situation where each passing relevant vehicle can be observed in a session, the total number of observed vehicles corresponds to the total session count.

Minimum manual traffic counts are made by counting all the passing relevant vehicles in the same lane(s) and in the same direction as the observation, during a 10 minute break in the middle of the session, or 5 minutes before and 5 minutes after the session. This break is in addition to the minimum 30 minutes (ideally for practicality min. 1h) observation session. If disaggregated results for different vehicle types are aimed for (optionally) then the vehicle types should be counted separately. Additional counting can also be done with an automatic counter during the whole session (e.g. loop on the road) so as to have an indication of the general traffic volume (optional).

3.6.5 Time of the year

SWD does not set a specification for time of the year (months). **Holiday periods (bank and school holidays) and hard winter conditions should however be avoided**, as these disturb normal traffic patterns. All months are allowed except for December-February to avoid a higher risk of (very) adverse weather conditions which may influence driver behaviour and can complicate the observational work (e.g. due to the weather conditions and shorter daylight periods), as well as July-August (in some Member States June too) to avoid typical holiday periods in the interests of representativeness. For the other months, sessions during official holidays should therefore also be avoided.

When Member States have historical series of measurements it is recommended to use the same periods of the year as for the earlier measurements. Member States intending to organise more than one roadside observation study to deliver the KPIs (e.g. one in Spring and one in Autumn) need to apply the minimum sample size requirements to the combination of both measurements. The data from both measures can be combined to deliver the indicators.

Regarding the impact of the COVID-19 pandemic on timing, it is recalled that the observation studies are ideally done in as normal driving situations as possible. Studies should not take place when a country or region is in a severe lockdown, with e.g. restrictions on journeys, closure of schools, and/or closure of non-essential shops. When less or less severe restrictions apply and there is a sufficiently normalised traffic flow (e.g. 75% of the normal flow), observation studies for distraction can be conducted. A night curfew is less relevant for the distraction study as daylight measures only are required.

4 Data analyses

4.1 Data coding

Detailed specifications for the data delivery and data matrix for the Baseline dataset will be provided at a later stage.

As a first guideline, it is suggested to include for each datapoint (i.e. each observation or each driver) in the dataset, the following variables:

- vehicle type (3)
- distraction: use or no use of a handheld mobile device (2)
- road type (3)
- date
- start hour
- end hour
- total observation duration
- unique location code (to know which observations belong to the same session)
- unique session code (only needed if the same location is used for different sessions)
- observation session duration
- traffic count duration
- traffic count total (at a minimum all relevant vehicle types together, ideally per considered type)

Variables such as road type, time period, location code, session code, day and time of a session, traffic counts can be coded once per session by the observers. These variables should then be added in the dataset to each datapoint (each observed driver) in the same observation session.

The following list gives some additional variables which can optionally be coded and included in the dataset:

- Coded per vehicle observation:
  - driver characteristics: age category, gender
  - presence of passengers
- Coded per observation session (once per session) and included in the dataset for each observation line from one session:
  - region
  - time period category (e.g. weekday off-peak, weekend day, weekday peak)
  - code of the observer(s)
  - weather condition
  - road condition
  - flow of traffic
  - number of lanes
  - observation lane(s)
  - observation direction.

4.2 Post stratification weights and statistical analysis

For each Member State, a general estimate of the percentage of drivers NOT using a handheld mobile device should be provided, as well as of the confidence interval (CI). Since the total population of drivers to which these estimates relate consists of the total of all vehicle movements over an entire territory over the entire period of the measurement, these overall estimates refer to the percentage of vehicle kilometres driven while drivers are not using a handheld mobile device.

For each level of stratification used for the sampling of observation locations – at least road type, but possibly also vehicle type, time period and region - results should be weighted according to traffic volumes by level of stratification. **The weighting should be done according to traffic volume data, at least by type of road.** If, optionally, other stratifications are also considered, then the weighting should be done according to traffic volume data by the considered stratifications (e.g. by region, by time period).

Traffic volumes are ideally obtained/estimated from national statistical mobility data (e.g. mobility surveys), and otherwise **should at minimum be estimated by using traffic counts during the observation sessions**. It is recommended to use the exact values for each combination of stratification levels considered (e.g. traffic volume

for motorways on weekend days in a certain region). If these combined data are not available, the second best option is to assume independence of all levels of stratification and use combinations of marginal totals to estimate specific combinations. The use of traffic volume data (either officially available data or traffic counts) is required to ensure comparability. The results of the Member States should be weighted in a similar way.

Even when national traffic volume statistics are available, traffic volumes should be counted during each control session. Since selection probabilities of observed drivers included in the sample depend on the amount of passing traffic during each observation session (traffic density), this information is also necessary to allow correct calculation of the confidence intervals (weighting). **When traffic counts are used to infer traffic volumes per stratum, (estimated) road network length by road type should also be considered for calculating the weights.** If no official data on roads lengths are available, it is recommended to request estimates from experts from the relevant administration services.

Statistical analysis techniques and tools should be determined by each Member State and these should be clearly described in the methodological report. Since driver sampling will typically be nested in locations, it is recommended to use appropriate multilevel models for two-stage stratified sampling (level 1: random selection of locations, level 2: random selection of drivers within locations). Approximations assuming simple random sampling can be used as long as results are weighted according to traffic volumes.

Further specifications on calculating weights (depending on available data) will be provided in a later stage.

4.3 Expected results and data delivery

For each indicator defined below, a point estimate as well as a 95% confidence interval is expected. Results should also include the unweighted number of drivers the result is based on.

The main indicator is the percentage of drivers not using a handheld mobile device across all day times and road types (locations). When optional vehicle types are included in the observations (e.g. trucks, motorcycles or bicycles), the main KPI should only include the three required vehicle types.

Furthermore, KPI values (point estimates and confidence intervals) are also required for each of the three road types.

It is optional to also provide estimates for specific categories of road users and for additional stratifications, if sample sizes are sufficiently large:

- by vehicle type (cars; possibly also light goods vehicles, buses/coaches)
- by time period (e.g. FERSI: weekday peak, weekday off-peak, weekend day)
- by region (if applicable)
- by age group (e.g. FERSI: young (18-24 years), medium (25 to 65 years), older (> 65 years))
- by gender
- by private vs. professional vehicle or driver (e.g. taxi)

It is also recommended to provide estimates for combinations of these, if sample sizes allow this.

For the **data delivery** to the Baseline consortium (inclusion in the Baseline database), three possible levels of aggregation are possible (*further instructions on dataset structure and variables will be provided later*):

(1) **Minimum level requirement: point estimates (%) for all categories of the minimum required levels of disaggregation (combination of the 3 vehicle types; road type (3)), and for any optional recommended additionally considered level of disaggregation, including confidence interval (CI) estimates.** The minimum output includes main effects of specific variables. Interactions are not mandatory.

(2) Medium level: crossed-level matrix of all considered levels of disaggregation (crossed point estimates) + CIs

(3) Ideal level: delivery of the raw cleaned data also. Cleaned data refers to correcting data (if possible) when improperly formatted or incorrectly recorded or to removing any incorrect or incomplete data that cannot be corrected or that are irrelevant or that are duplicated. This data is usually not necessary or helpful when it comes to analysing data because it may hinder the process or provide inaccurate results. Note: observations with incomplete data should only be removed if one of more of the minimum required variables is missing. The minimum driver sample sizes refer to "valid" datapoints in the dataset after data cleaning.

4.4 Methodological report

Member States should draft a **methodological report** and deliver it with the data. This methodological report should include at least the following:

- the study design, including the vehicle types considered
- the method used and rationale for choosing the locations (sampling method, inclusion/exclusion criteria, minimal traffic flow considered)
- the fieldwork procedure (planning of session/hours, method to record the observations, considered prerequisites for a session, days of the week and hours of the day, crossed designs, variables collected, months on which the observations took place)
- the statistical techniques used to weight the data, to calculate the CIs, and to analyse the results
- **metadata** on the applied regulations and procedures related to this KPI (e.g. legislation on mobile phone and/or device use)

5 Requirements for automatic detection via roadside cameras

SWD also allows other observation methods if available, e.g. automatic detection. Smart cameras could automatically detect whether drivers have a mobile phone or device in the hand. This technology seems promising and could have clear advantages as compared to using observers in terms of e.g. reliability, data collection duration, night time use… Possible drawbacks should however be evaluated (e.g. lacking variables). This is new technology on the market and should therefore have been tested and validated before use. For privacy considerations, faces should not be caught on camera.

Example pictures:

The experience with such smart cameras for detecting mobile device use, in enforcement and certainly for research purposes, is still very scarce. Stelling-Kończak et al. (2020) recently performed a study into various enforcement methods for mobile device detection including camera-based enforcement. Some insights and conclusions from their study are:

- *Cameras can be fixed (unmanned; mostly installed for weeks or months) or mobile (manned, easily movable from location to location; e.g. placed device on the ground), as well as have different levels of intelligence or smartness:*
- *not intelligent: camera makes images of all passing vehicles and these have to be manually checked*

- *partly intelligent: camera makes images of drivers that presumably are using their mobile device (based on intelligent image recognition software) and these have to be manually confirmed*
- *fully intelligent: camera fully automatically identifies drivers using a mobile device (based on intelligent image recognition software) without a need for a manual confirmation.*

Such cameras are still rarely used (for enforcement), and if used, responses indicated that slightly more often mobile cameras are used than fixed, and so far only not or party intelligent cameras. As yet, 'smart', partly automated cameras are only used in a few countries, among which Australia, Saudi Arabia and (on a small scale) the Netherlands. […] The most important reasons mentioned for not using these cameras are: technical and legal barriers and for mobile cameras the high costs.

Technical issues such as polarizer filter and infrared light for night and bad weather observations are often present. Viewing angle positions have to be changed in order to observe either lower vehicles (cars, vans) or higher vehicles (trucks). Not all cameras can be placed on all road types (motorways, urban and rural roads). Mostly they are placed at a height. The steeper the viewing angle, the deeper the view inside the vehicle can be.

In the Netherlands different legislations specify that police are allowed to use these cameras. Based on the first trials with their mobile camera, they conclude that improvements of the technology and legal interpretations are possible (image not always sufficiently clear, not always sufficiently visible if there is a device in the hand).

A general concern about the use of such cameras (mainly in the USA and Australia) is that they are a violation of privacy because an image is taken from the driver (and passengers). Generally this violation of privacy is [or can be] minimised by erasing pictures without an offence immediately. In the Netherlands furthermore passengers are automatically detected and if so, that part of the image is automatically 'masked', so not visible during the manual check/confirmation.

Experiences [with partly automated cameras] are positive, but new technological developments are expected to offer more application possibilities. Thus, artificial intelligence will presumably make it easier to recognise offenders, reducing the time needed to manually check and confirm the images. … The difficulty with … camera-based enforcement is that drivers often try to hold their phones in such a way, for example on their laps or close to the car door, that they are hard to detect from the outside. … For camera-based enforcement a good view inside passing cars is also important. To achieve this, cameras should be directed downwards at an angle that is as straight as possible. In addition, further improvements are possible in preventing light reflection from windscreens and in the ability to simply combine monitoring of car drivers on the one hand, and truck and bus drivers on the other hand."

Proposed further reading by the authors:
https://roadsafety.transport.nsw.gov.au/stayingsafe/mobilephones/technology.html

When smart cameras are used, in general, the same minimum requirements, expected results and data delivery as for roadside studies with observers apply (see Sections 2 to 4): with regard to vehicle types (inclusion of 3 vehicle types: cars, vans and buses/coaches), road types (motorway, urban and rural roads) and locations (as random as possible), time of the observation (mixed time intervals at daytime hours on weekdays), sampling (random) and sample sizes (min. 10 locations per road type, min. 2,000 drivers (combined for the 3 vehicle types) and min. 500 drivers per road type).

Member States aiming to use cameras should evaluate the feasibility of these minimal requirements for delivering the KPI for distraction. Some issues are for instance:

- Which national (regional, local) regulations (admission, procedures…) apply to using this method
- What is the reliability of the camera (false negatives, false positives)
- Because data collection is not only required of drivers using a handheld device, minimally the number of all passing relevant vehicles during the observation should be counted. Ideally, data collection (images) includes both drivers with and without a handheld mobile device. This would allow a manual check, although time consuming, and may allow also coding additional variables, such as driver variables.
- Can vehicle type be determined by the image (car, van, bus/coach)? The data collection should include these three vehicle types at a minimum; if other vehicle types are also included the type of vehicle should be coded, because disaggregated results are then needed.
- If cameras made for deployment on overpasses are used, this restricts the random location sampling procedure and may also complicate the inclusion of the three road types.

Member States aiming at using this technology should provide **detailed information in the methodological report** on the technical aspects of the camera, sampling procedures (locations and drivers; vehicle types included), camera

accuracy (false positive/negative ratio), data-collection/coding procedures, data quality and correction procedures, data treatment, and data analysis including weighting procedures. As for the roadside studies with observers, the results should be weighted according to traffic volumes by type of road (and other considered stratification variables). The dataset should minimally include datapoints for handheld mobile device users and non-handheld mobile device users, including the minimum measurement session variables in which the observations are nested (location code, road type, date, start and stop time… see Section 4.1).

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Annexes

Annex 1. SWD KPI 5 for driver distraction by handheld devices

Ref: Commission Staff Working Document - EU Road Safety Policy Framework 2021-2030 - Next steps towards "Vision Zero, SWD (2019) 238, https://ec.europa.eu/transport/sites/transport/files/legislation/swd20190283-roadsafety-vision-zero.pdf

Rationale

Driver distraction is considered as a collision factor of growing importance due to the increased use of mobile devices - mainly smartphones - during the past years, and the widespread use of texting applications has aggravated the existing problem of phone calls. This is why the use of a handheld mobile device while driving is proposed as a proxy to assess the driver distraction problem.

Definition of the KPI

Percentage of drivers NOT using a handheld mobile device.

Minimum methodological requirements

Data collection method	Direct observation by trained observers on roadside or from moving vehicles. Other alternatives could be used if available, e.g. automatic detection. To be decided by Member States.
Road type coverage	The indicator should cover motorways, rural non-motorway roads, and urban areas. The results may be presented separately for these three different road types.
Vehicle/user type	Cars, light goods vehicles, buses/coaches as a minimum. Other user types if possible (disaggregated by user type).
Location	Random sample (methodology for Member States to decide).
Time of day	Observations to take place during daylight.

Annex 2. Rationale behind the minimum sample requirements

The methodological guidelines for all KPIs are designed to ensure international comparability between KPI values while taking into account feasibility and affordability. To that end the methodological guidelines have been defined in such a way that accurate and representative results can be obtained for all parameters of interest at a reasonable cost.

Obviously, the larger the sample of observations and locations for observation, the more accurate the KPI estimates for the different strata will be (e.g. a KPI value for a particular type of road, or a particular part of the week). Increasing the number of observations and locations however implies increasing field work costs. Statistically, the required minimum sample size depends mainly on the desired accuracy of the final estimates, for which no absolute value can be determined *a priori*. Therefore, for the main KPI estimates a pragmatic evaluation was made of the expected confidence intervals at different sample sizes and population parameters. Giving priority to feasibility and affordability, as a rule of thumb the minimum total number of observations was set at 2,000, the minimum number of observations for different strata at 500. It was agreed that this should allow to identify statistically meaningful differences between countries at an affordable price. For some countries, this will imply disproportionate sampling of certain strata compared to the distribution of traffic volumes over different strata. This is however required to allow statistically meaningful international comparisons at the level of each of the strata at interest.

The same pragmatic logic was followed for determining the minimum number of 10 locations for observation for each of the required road types of interest. Once again, there is no statistical rationale for determining the required minimum number of locations to ensure representativeness of the observations for the entire country. This mainly depends on the amount of variance between locations and within a country. Giving priority to affordability, a rule of thumb was also used to define the minimum number of locations at 10 per stratum. In order to ensure representativeness for the entire country larger numbers of locations might be required for larger countries. Taking field work costs into account, it was however decided to only identify the minimum requirements and leave decisions on the final number of locations to the discretion of the member states. Equally importantly, in order to ensure representativeness of the measurement locations these should be randomly selected as far as possible.

The main objective in defining the minimum methodological requirements is to keep a balance between affordability of the field work and the requirements to make meaningful international and historical comparisons. Therefore, the emphasis is placed on the minimum requirements that can also be taken into account by smaller countries. It is however of interest to any member state to increase the accuracy of the KPI estimates by boosting the number of locations and the number of observations.

Annex 3. Overview of the main FERSI recommendations

Ref: Vollrath, M., Schumacher, M., Boets, S., & Meesman, U. (2019) Guidelines for assessing the prevalence of mobile phone use in traffic. FERSI technical paper. Retrieved from https://fersi.org/wp-content/uploads/2019/11/Guidelines-prevalence-mobile-phone-use.pdf

FERSI
Road Safety Research

5. Summary and overview of recommendations

The next three Tables present an overview of the most relevant recommendations related to the estimation of point prevalence of mobile phone use in traffic, distinguishing between BAsic (BA) recommendations for epidemiological studies (Table 2), recommendations for Roadside Observational Studies (ROS; Table 3), and recommendations for Self-Report Studies (SRS) - roadside interview, telephone interview, and online survey(Table 4).The list of recommendations is not aimed to be exhaustive.

Table 2: Summary of BAsic (BA) recommendations for epidemiological studies

BAsic (BA) recommendations for epidemiological studies	
BA1	In all epidemiological studies a thorough control and documentation of possible influencing context factors is needed (e.g., region, road type, traffic density, day of week, time of day, weather).
BA2	In all epidemiological studies a uniform definition of basic tasks should be used.
BA3	The main distraction categories should be assessed in all epidemiological studies. When reporting the results, the full definition of the categories should be given.
BA4	In each epidemiological study, a core set of subject characteristics should be included.

Table 3: Summary of recommendations for Roadside Observational Studies (ROS)

Recommendations for Roadside Observational Studies (ROS)	
ROS 1	To estimate the extent of the problem of mobile phone use in traffic, or to investigate the effect of a campaign or legal measure, observational studies deliver most direct and valid data, and are therefore the preferred methodological option.
ROS 2	To better understand the subjective background of mobile phone use in traffic or to describe the traffic participants' behaviours in more detail, self-report studies are more suitable.
ROS 3	To get a full understanding of the problem of mobile phone use, a combination of ROS and self-report studies is recommended, taking the advantages of each method while compensating for their shortcomings.
ROS 4	When planning an observational study a set of basic methodological aspects should be considered. These should also be documented in the report.
ROS 5	The report should include an exhaustive definition of all variables which are observed or are recorded.
ROS 6	Each observational study requires a thorough training of the observers including a performance test to ensure a high inter-rater reliability.
ROS 7	The rationale for choosing the locations of the observations should be provided.
ROS 8	The basic characteristics of the observation sites should be recorded and included in the report.
ROS 9	Observations should cover the whole daytime and different working days. This can be achieved by selecting at least three time-intervals per day and by doing observations at least from Mondays to Saturdays.
ROS 10	In order to ensure a high quality of the data, observations should only be done if some basic requirements are met (e.g., weather, light, road condition).
ROS 11	External validity of the results requires that the target group is clearly defined.
ROS 12	For car drivers, cyclists and pedestrians the observation study should always include private traffic participants (including those on their way to/from work) as they represent the largest part of traffic.
ROS 13	Target objects should always be randomly selected from all the possible objects at the location where the observation is done.

ROS 14	For the observers, there has to be a clear definition which of the traffic participants belongs to the target group with regard to their characteristics, but also their location.
ROS 15	It is recommended to use tablet computers for the observations.
ROS 16	At the beginning of each observation session, a key set of variables describing the location should be recorded.
ROS 17	When planning the study, the appropriate sample size should be estimated and used to determine the required number of observational sessions, taking the different types of traffic participants (car drivers, cyclists, pedestrians) into account.
ROS 18	When selecting the locations of the observations, it must be ensured that the observations can be conducted safely and inconspicuously.
ROS 19	Each data set (one observation) should include the information about the location and observation time as well as the individual information about the traffic object observed.
ROS 20	Data could be weighted according to traffic volumes at the different locations of observation.
ROS 21	Even more importantly, when the results aim to be representative, a weighing with regard to relevant characteristics of the traffic participants and their mobility should be done.

Annex 4. Summary overview of on-road observation study requirements and recommendations

SWD minimum requirements	Baseline minimum requirements for on-road observation study	Baseline recommended options for on-road observation study
KPI: % not using a handheld mobile device - Method: observation - Road type: rural, urban, motorway - Vehicle type: min. cars, light goods vehicles and buses/coaches - Locations: random - Time: day	- % no device in the hand + CI aggregated - % no device in the hand + CI per road type (3) - Direct observation by well-trained observers along the road or from moving vehicles - Locations: good view, safe, inconspicuous - Min. sample size: 2,000 observations for the 3 vehicle types together (it is allowed not to report disaggregate data for the three included vehicle types) - Min. 500 observations/road type (3) - Min. 10 different locations/road type - 1 location = min. 1 observation session of min. 30 minutes - Fieldwork organisation: mix of daytime hours: on and off peak on week days, balanced over road types/locations - Not during holidays or heavy winter period - Exclude observations of stopped vehicles, include all other - Traffic counts during sessions (10 min) for weighing data + estimates of road network length (3 types)	- Boost sample size for more accurate estimates and further (crossed) stratifications - Geographical coverage - Complete disaggregated data (crossed strata) - Different types of distraction - Driver characteristics - Exclusion of locations with <10 vehicles/hour is allowed - Time period stratification: week day peak, week day off-peak, weekend day (min. 10 locations per time period; min. 2 locations per time period x road type; min. 500 observations/ time period) - Region stratification (e.g. NUTS1; min. sample size separately) - Vehicle type stratification (min. sample size separately) - Use available traffic volume data to sample locations and to weigh data according to included stratifications