EU Transport Statistics

EUROSTAT GUIDELINES ON
PASSENGER MOBILITY STATISTICS

2021 edition

MANUALS AND
GUIDELINES

eurostat

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List of abbreviations

CAPI:	Computer Assisted Personal Interview
CATI:	Computer Assisted Telephone Interviewing
CAWI:	Computer Assisted Web Interview
CNG:	Compressed Natural Gas
EV:	Electric Vehicle
EC:	European Commission
EFTA:	European Free Trade Association
EU:	European Union
EU SILC:	European Union Statistics on Income and Living Conditions
F2F:	Face to face interviews
FUA:	Functional Urban Area
GHG:	Greenhouse Gas
GNSS:	Global Navigation Satellite System (e.g. the European Galileo or the American GPS)
HBS	Household Budget Survey
ITF:	International Transport Forum
LAU:	Local Administrative Unit
LFS:	Labour Force Survey
LPG:	Liquefied Petroleum Gas
MiD:	Mobilität in Deutschland (The German NTS)
MOP:	German Mobilitäts Panel (The German Mobility panel)
MS:	Member State
NSI:	National Statistical Institute
NTS:	National Travel Survey
NUTS:	Nomenclature of Territorial Units for Statistics
OECD:	The Organisation for Economic Co-operation and Development
PAPI:	Paper-and-Pencil Interviewing
UNECE:	United Nations Economic Commission for Europe

Background

Passenger mobility statistics are not currently part of the regulated European Statistical System. There is no regular and harmonised data collection in the field of road passenger traffic statistics as already exists for other modes of transport such as rail, air or maritime transport in accordance with legal acts. However, with an increasing need for monitoring the development in passenger mobility linked to the European Union transport policies Eurostat is making efforts to develop harmonised methodology to assess passenger mobility in EU. The Guidelines at hand are a result of the effort to develop a methodology for this purpose.

These guidelines are developed in cooperation with the members of the Task Force on Passenger Mobility Statistics, which has been set up for this purpose. They are based on the conclusions of a Eurostat Seminar on Passenger Mobility held in 2013 and they are drawing on input from other relevant projects such as the COST/SHANTI and the EU 7th Framework project OPTIMISM. The current document is an updated version of the Reference Manual developed in 2014-2015, which includes remarks from Task Force on Passenger Mobility Statistics and the Coordination Group for Statistics Transport (CGST).

The actual version of the guidelines is the result of the following steps:

- An information collection round from relevant projects such as COST/SHANTI and OPTIMISM.
- The analysis of existing data on passenger mobility statistics available at Eurostat.
- Information received from the Eurostat Seminar on Passenger Mobility (2013). An analysis of requirements from DG MOVE.
- An analysis of existing data collection practices through National Travel Surveys or similar.
- The analysis of remarks received from the Task Force Meeting on Passenger Mobility Statistics, which took place in Luxembourg on the 10th of April 2014, as a result of a first presentation of information.
- Collected remarks from Member States as a result of the Coordination Group for Statistics Transport (CGST) in July 2015
- The analysis of remarks and comments provided before, during and after the second Task Force Meeting on May 21st 2015
- Remarks from the Task Force Meeting on April 28th 2016
- Results from the Grants on passenger mobility from July 2015 and July 2016
- Remarks from the Task Force Meeting on September 21st 2017
- Remarks made during the Task Force Meeting on October 11th 2018.

Under the preparation of the guidelines a main information source for the Guidelines is contained in Chapter 3 of the COST/SHANTI final report (Armoogum et al., 2014), where an overview is presented of "Recommendations for Obtaining Comparable Results from National Travel Surveys". The recommendations therein are compared and completed with the findings from several studies done by Agilis (including the metadata questionnaire findings), the UNECE handbook on statistics on road traffic and Work Package 2 from the FP7-OPTIMISM project (Deliverables 2.2 and 2.3).

1. Introduction and overview

1.1. Background for data collection on passenger mobility statistics

There is an increasing need for relevant information to be collected on passenger mobility so that the European Union policies linked to this specific transport activity can be properly monitored. First of all it is important to be able to follow the development in relation to two of the goals stated in the European Commission 2011 Transport White Paper[1], 1) halve the use of conventionally-fuelled cars in urban transport by 2030 and phase them out in cities by 2050, and 2) to have the majority of medium-distance passenger transport to go by rail by 2050.

Passenger mobility surveys or National Travel Surveys (NTS) exist in a number of Member States. In some cases they are one-off exercises that are not intended to be regularly repeated while in other countries they are conducted on regular or semi-regular basis or even on continuous basis. Moreover, several EU Member States are still in the preparatory phase before launching their first NTS and some are not even considering launching a NTS.

The existing surveys do not follow a harmonised methodology at European level and are primarily designed to respond to national information needs. On the other hand most of the surveys are following similar main structures and are asking the same main questions so that harmonisation will only need some adaptations. Countries which already have a long tradition of NTS are reluctant to introduce major changes for the sake of preserving their long times series. For those countries, it is recommended to continue conducting their national travel surveys and producing their indicators for national policy as usual. However, by applying the method of post-harmonisation and with some adaptations, survey results can hopefully be more tailored to EU policy needs.

The purpose of these Guidelines is to outline a common and harmonised data collection at which the core information is collected for all countries conducting a NTS. For countries which have not yet carried out a NTS, a main purpose is furthermore to transfer experience on how to conduct a well-functioning NTS from countries which have managed this since years.

The main objective for the harmonisation recommendations is to avoid a situation where a country is leaving out a variable or a value of a variable from the questionnaire which could easily be collected but from a national point of view is not important. An example of missing core variables and values can be found for the Spanish NTS MOVILIA. The survey did not ask for travel distance of the trips, it only asked for travel time. From a national point of view this might be sensible because travel duration is often more precise than distance. However, when evaluating environmental effects traffic distance is a core variable needed for calculating the emissions. Examples of variable values which were missing are the possible answers to the question about mode choice. Walking and biking were grouped into one value probably because biking is very seldom in Spain. However, afterwards nobody knows if biking is seldom or just missing in the questionnaire. This is especially a problem when comparing results from several countries.

1.2. Drafting of Eurostat Guidelines

The objective is to create Guidelines on Passenger Mobility Statistics which at the one hand is reproducing best practices in Europe and on the other hand allow for monitoring the development of passenger transport in Europe.

The content of the document should be considered as a guideline for countries which are willing to start a NTS as well as countries which already have a NTS and wants to harmonise this with other surveys. By no means these guidelines are to be considered as the final “one and only” way forward. The aim is that the

[1] http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52011DC0144

outcomes of the different NTS are comparable between countries and over time.

Comments and suggestions from the Member States are therefore very much appreciated.

1.3. Document structure

The document is organised in the following chapters:

- A set of definitions used throughout these guidelines, explaining specific terms and expressions. They determine the variables and breakdowns that make up the data collection on passenger mobility, and are critical in guaranteeing the comparability of end results.
- Recommendations on a harmonised set of indicators on passenger mobility, which are most relevant for the monitoring of the EU policy needs and which all EU Member States and candidate countries should aim to report. The recommendations focus on two distinctions: (1) urban mobility vs. non-urban mobility and (2) passenger mobility over different distance classes.
- Recommendations are formulated on survey methodology as well. It points to examples of current national best practices and recommend the use of a harmonised methodology whenever possible, and/or a limited number of equivalent alternative approaches where more appropriate.
- In addition, the Guidelines comprise a chapter describing the method of post-harmonisation of national surveys results (inspired by the approach described in the final report of the COST/SHANTI action), addressed mainly to countries who already have a long tradition of national travel surveys. The Guidelines presents suggestions for ad-hoc extractions from raw data with data grouping more tailored to EU policy needs.
- Recommendations of survey design including elaborations on methodology. The recommendations are synthesis of the definitions and indicators presented in the chapters before and the experience from NTS conducted by Member States during the last decades. These recommendations are a minimum basis for harmonisation, which should not discourage national initiatives for a wider scope (for instance, no age limit for the respondents would simplify the calculation of car occupancy).
- Three appendices are included: i) list of functional urban areas; ii) a list of current national practices regarding the different options suggested in the definitions and indicators; and iii) sample questionnaires from MSs.

When reading this document, it is important to know that there are in fact three levels of stakeholders involved and two types of questionnaire associated to these levels. The main stakeholders involved are:

- Individual respondents (lowest level of aggregation) that complete NTS and provide (raw) micro-data on mobility behaviour.
- Countries (medium level of aggregation), who provide both the collection and analysis of data from NTS that are executed on their territories.
- Eurostat (highest level of aggregation), as a central data collection point for variables and indicators on passenger mobility presented by individual countries.

As such, the two questionnaires mentioned in the document are:

- Two models for questionnaires used in NTS and retrospective surveys (presented in Chapter 6) that can be used by individual countries to collect micro-data on passenger mobility behaviour from individual respondents.
- A model survey for the forwarding of (aggregated) passenger mobility statistics from countries to Eurostat (presented in Chapter 7).

2. Definitions used in these guidelines

2.1 Introduction

This chapter contains recommendations on definitions for relevant terminology that is used for the indicators, the methodology description and the template / model surveys. The definitions are required to carry out the surveys in a harmonised way and to analyse the data collected.

This actual chapter is split into five sections. After this short introduction, the second section (2.2) contains the terminology which is used in surveys for short distance travel. (2.3) presents definitions especially related to medium and long distance travel when these are different from the definitions in the short distance survey. The fourth section (2.4) contains the definition which has been chosen for urban area and how it can be used for data collection on urban mobility. Finally, in section 2.5 the quality indicators used for reporting passenger mobility statistics are defined.

2.2 Terminology for urban and short distance mobility

Within this section, definitions are presented for the terminology used in this document. These are typical expressions used in NTS during data collection and reporting of findings. The purpose is partly to clarify what is meant when various definitions exists and partly to show the definitions that are most fit to purpose when collecting data from the MSs in a harmonised way. The objective is to obtain sufficient information for monitoring purposes with a minimum of burden on the MSs. Most of the terminologies have been presented in earlier version of the guidelines; however, some slight adjustments have been necessary after closer considerations and recommendations from the MSs.

The focus is on terminology that requires a specific definition in order to enhance comparability between countries. For each terminology, the following information is presented: definitions chosen for data to be delivered, elaboration on the definition, value of the indicator and description on how to calculate them (if needed).

Reference population

Definition

The **reference populatio**n for the compilation of indicators should include **all country residents aged 15 to 84 inclusive.** This should not limit MSs to collect data on a wider scope. But at the end of the day, there should be a possibility to calculate indicators for all country residents aged 15 to 84 inclusive.

Elaboration

The term ‘reference population’ refers to the population group for which the collected information is meant to be representative and it usually means the entire country population. The country population includes all inhabitants of the territory irrespective of kind of residence and including any non-nationals with a residence in the country.

The definition specifically includes persons, who are resident at institutions, prisons, boarding schools or any other kind of permanent residence in the country. In most countries, it is impossible/impractical to survey (parts of) these groups; this should be regarded as a representativeness issue, not an exclusion.

Within the context of National Travel Surveys many European countries currently apply lower age limits (varying between 6 and 16) and most countries have no upper age limit. The choice of using such age limits on respondents to be included in the sample and hence also on the reference population reflects various data needs of national transport policies and should therefore be left to the countries. However, in order to maintain comparability between countries, it is recommended that all countries provide the requested indicators for the age group covering respondents from 15 years old up to 84 years old (inclusive), which corresponds to a large extent to what constitutes at present the smallest common denominator for National Travel Surveys in Europe.

Respondents, Trip-makers (or travellers) and share of trip-makers among respondents

Definition

Respondents (net sample) are those among the original sample who actually **took part in the survey** and whose questionnaire is considered valid.

Trip-makers are those respondents who declared at least one trip on the travelling day**.**

The share of trip-makers is the number of weighted trip-makers divided by the number of weighted respondents.

Elaboration

A trip-maker in these guidelines is defined as a respondent who reported at least one trip on the travelling day (the travelling day is the day or days the diary of the survey is referring to). The opposite is no-trip makers.

A subset of the no-trip makers are the "immobile" people, who are not travelling at all during a longer period. The share of trip-makers is the share of the population with at least one trip on the travelling day. The share is typically changing over the week with the lowest share on Sundays and the highest share during working days. This share is normally somewhat higher in urban areas than in rural areas and also among respondents in active employment than for retired people.

Currently, there is a strong difference in the share of no-trip makers across European NTS (ranging from 8% to 28%) which is believed not to be due to real behavioural differences but to be strongly influenced by the survey methodology. It is important to be aware of this when comparing indicators which have been calculated per respondent rather than per trip-maker. Having the information of the share of trip makers from all countries could allow re-calculation of the indicators per respondent into indicators per trip-makers or vice versa and by doing so to exclude some of the impact of methodological differences across countries.

Calculation of the share of trip-makers

The calculation of the share of trip-makers depends on the survey methodology:

1. If the survey is conducted as a one-day survey, the number of trip-makers is the overall number of respondents who have had at least one trip on the travelling day. The share of trip-makers is the number of trip-makers divided by the total number of respondents.
2. If a survey is a multi-day survey, the calculation is more complicated. The share of trip-makers has to be calculated for each day by dividing the number of respondents with at least one trip on the actual day by the number of respondents who have responded for that day. The share of trip-makers is calculated as the average of the share of trip-makers for each of the days during the entire reference period. The share can be calculated for working days and for non-working days separately. In practice this means that e.g. for a 7-day survey (such as the British NTS and the German MOP) the seven days of the same respondent have to be treated as seven days filled out by seven different individuals.

The number of respondents and the number of trip-makers have to be calculated as weighted data.

All days, working days, non-working days

Definition

All days are defined as the 365 (366) days of the year

Working days are defined as the 5 weekdays, Monday-Friday, excluding official holidays

Non-working days are defined as Saturday, Sunday and bank holidays

Elaboration
Bank holidays are days, where most working places and most shops are closed. The precise definition is specific to each MS. In states with a legal definition of bank holidays, this should be used, if in accordance with general, public practice.

Holidays that are local or only apply for a subset of the labour market do not qualify as banks holidays. This implies that inter alia, school holidays and city holidays are not regarded as bank holidays.

It is not necessary to collect data for every single day of the year, because a representative sample of days may be weighted to working days/non-working days/all days, respectively. But it is recommended that the data collection should be spread over a full year (even if it's not collected for every single day).

Countries are using different methods when reporting data from the NTS for national purposes. However, most countries are properly registering if a weekday is an official holiday. It is therefore preferable to use the definitions Working days / Non-working days for the indicators to be generated. For countries which have not yet registered the official holidays and are not able to ex-post register it based on travelling dates, it is acceptable to use the alternative definition for the indicators.

Holidays are defined as official holidays declared by law or similar or as an official agreement for the whole labour market. Official school holidays and the business summer holiday etc. are not included in the non-working days. The same is the case with weekdays during Christmas and after Ascension Day which many companies have declared a holiday. For some countries, for instance Germany, official holidays are at different dates in different regions. In case the MS has decided to register these different dates for the sampled respondents dependent on which region they live in these dates can be used as non-working days for the relevant part of the sample. Local holidays only relevant in one city or a few municipalities are not included in the non-working days in any case.

All indicators should be delivered per day weighted up to a year. For countries doing a survey all year round and including one travelling day no extra calculations are needed to find the indicator per day.

It is recommended to register the precise day of the week and not only weekday and weekend. Especially Saturdays and Sundays have quite different traffic patterns for e.g. shopping and leisure. Also the weekdays are different; especially Friday is different from the first 4 weekdays.

Trip

Definition
A **trip** is the movement from an origin (stay) to the next stay, the destination. The origin and destination may have the same location or purpose, where the trip is the movement in between. A trip could be made in one or a series of stages.

Professional transport trips (defined precisely below) are excluded from the indicators.

Trips taking place fully on foreign territory may be excluded.

Elaboration
This concept of a trip is commonly used in all countries, with minor deviations, especially on the handling of loop trips. Loop trips are trips with origin and destination being identical and no other stay, or in other words: single trip journeys.

A journey is the entire collection of trips from home, back to home.

The basic key to the trip definition is that the number of destinations (stays) is equal to the number of trips (minus 1, when reporting for a finite time span). Any stay, which dominates the trip chain, should be counted as a destination = new trip.

Examples on destinations, which forms a stay, initiating the next trip:

- Picking up somebody (colleague, child,…), cf. purpose "Escorting"

- Refuelling the car, when the visit at the petrol station is the purpose of the trip
- Buying a present to the hostess of the next visit
- Any stay on a trip, that otherwise would be a loop trip
- Lunch break, when the respondent leaves the premises, is reported as 2 trips: to lunch and from lunch. As the break is not the working activity, the break belongs to purpose “Leisure”.

Examples on stays, which are not destinations with regard to the trip definition:

- Buying a ticket for immediate travel
- Waiting for an airplane, train, bus, ferry, railway crossing or in a traffic jam
- Refuelling the car, when the petrol is used for onward travelling
- Break at a rest area by the road (when this is not the sole purpose of the trip)
- Buying a cup of coffee or meal, which is consumed on the same trip (when this is not the only destination)
- Picking up a hitch-hiker on the road
- Border crossings

(Time used at these non-destinations should be included in the total travel time).

Examples which are not a trip, because they are considered part of the same stay, are the following:

- Visiting several shops in the same shopping centre is considered internal at the premises and not a trip
- Walking between two buildings of the same complex, without touching public roads
- Conducting more than one activity on the same stay – e.g. a bank and a shop in the same shopping centre

(Time used for these non-trips are considered part of the dwell time at the destination)

Loop trips may be surveyed in two parts, divided by an artificial destination. In this case, the trip count should be corrected such that the entire trip is counted as one. This conversion is trivial when the affected trips are identified.

Our recommendation is to report the loop as one trip, as the majority of countries are doing. It is important to register the purpose of the trip as a leisure trip and not by the purpose ‘home’ (see below for purpose). If the respondents takes a rest during the trip for coffee or eating or just for sightseeing, it would be good to register this place as a destination and not call the entire trip a loop. The same applies for long sightseeing trips e.g. longer than 5-10 km. Another question in the trip concept refers to stopovers during a long trip e.g. stopping for refuelling, taking a coffee break or having a pause to consume a meal along a motorway. In the definition of a trip, such stopovers are a part of the trip if they are not a purpose the respondent is travelling for. Only in case it is a loop the stop would naturally be a destination. Similarly, shopping or eating at a station when changing mode is a part of a trip.

Some short distance trips (up to 300 km) might cross one or more country borders. While these trips are not very frequent, they can nevertheless have significant impact on indicators based on the total travel distance. Countries have different practices with regard to the collection of these trips; some collect only domestic trips, some collect the trip up to the border too, and some collect the full trip, the whole way to / from the international destination). However, to ensure the comparability of data across countries, for the purpose of the compilation of indicators to be provided, all international trips should be treated by similar rules. In these Guidelines trips up to 300 km starting or ending in the country of residence and crossing one or more country borders should be included in the short distance indicators whereas trips taking place fully on foreign territory should be excluded when calculating distances of trips up to 300 km. When choosing the above mentioned definition of a trip with a stopover for eating and fuelling this means that most often only trips after the first overnight stay and trips after arrival at the destination will be considered as trips in the foreign country.

Professional transport will generally contain a large number of trips, which are excluded from the indicators. Professional transport is any trip where the actual mileage is the professional business. This exclusion applies for professional bus/lorry/van/train drivers, as well as for newspaper deliveries, police on patrol, driving school teachers, bus conductors, etc.

The “return to home” trips should not be forgotten. Also, it is recommended not to limit the number of trips to be described.

Stage

Definition

A **stage** is a movement making use of one transport mode, including any waiting time directly before or during the movement. A stage is defined by one single mode of transport.

However, it is suggested to let the MSs themselves choose if a change of mode of the same type should be taken as two stages or only one. The waiting time between the two vehicles has to be included in the stage(s).

Elaboration

The stage definition has multiple interpretations: Either “mode” as the physical vehicle or mode as the generic mode of transport. The difference rises in cases with change between two vehicles of the same mode within the trip, e.g. change between “bus 1” and “bus 2”. This detail is to be decided by the MS, as the difference regards possible national applications of the data.

It is strongly recommended to collect information on lengths and durations at the stage level, as this decision governs whether e.g. car driving as access to public transport is included in the statistics. Recommendation is for the diaries to be collected for each stage of a trip. This is first of all because the resulting mileage per mode is different for stages and main modes; especially mileage by walking and by bus is lower for main modes than for stages. Countries not yet having adapted their travel surveys to include trip stages are asked to at least provide the information on the main mode of travel used during each trip.

The terminology ‘stage’ is commonly adopted in countries. One underlying definition for the different interpretation of the terminology ‘stage’ is that it is linked to a single mode of transport (or type of vehicle used).

Variations exist depending on whether it is a continuous mobility action or not, and whether waiting time is included in the stage or not. It is suggested to leave it to the countries if stages should be defined per vehicle or per type of mode.

Example 1: biking from home to the train station, taking the train and then walking to work comprises three stages.

Example 2: changing from one bus to another bus is considered an interruption. Still, this comprises two stages.

Distance

Definition

Distance is defined as the length of the travelled track (normally along roads). Only distances on public areas, roads, paths, rails and seaways are included.

As measurement unit “kilometre” is used for distance. For distances less than 1 km it can be registered as kilometre with one decimal (0.1 km for 100 m).

Precision: For trips over 0.1 kilometre, the distance should be registered with one decimal. For trips shorter than 0.1 kilometre, the distance should be registered with two decimals.

Elaboration
Distances are used for both trips and stages. The distance for a trip is defined as the sum of the relevant stages.

It is recommended to collect distances by asking the respondent about it and to verify the distance based on the Euclidean distance between origin and destination (crow fly distance).

Trips through a private garden or in the farmer's fields are not included in the distance. If the entire trip goes through private areas it should not be included in the survey.

Euclidean distance is not to be provided by the respondent unless it is flying or sailing. Distance by roads is normally 1.3 times longer than the Euclidean distance. However, it depends on the travel distance (for long distances the detour factor is normally smaller), type of area (in rural areas the difference is often higher than in urban areas) and possible waterways or mountains between origin and destination (increases the detour factor at long distances).

Many countries only accept trips longer than a certain minimum distance. It is recommended to make the minimum distance as short as possible, e.g. 100-200 meter.

For short distances, care should be taken to avoid registering e.g. 500 m as 500. The correct indication is 0.5 km.

Travel time

Definition
Travel time for a trip is the duration from the moment of departure from one activity to the moment of arrival at the next activity.

Travel time for a stage is the duration from "begin waiting for" until "alighting from" the mode.

Elaboration
Travel time is used for both trips and stages. The definition implies that the travel time for a trip is the sum of the travel times (incl. waiting) for the involved stages.

In the questionnaire, it is recommended to collect waiting time and in-vehicle time separately and then add as travel time in the post processing.

Duration of a "non-destination" and waiting time is regarded as a part of the stage after the wait.

Travel time for a stage is the time spent from starting to wait for a mode until the time of leaving this mode (or type of mode).

The central element in the definition is the time between departure and arrival. The inclusion of waiting time could possibly cause a problem for the registration of data (insofar that non-automated mobility registration collection methods are concerned). In practice, it is recommended to register the waiting time separate from the travel time and use the sum for reporting indicators.

Distance classes

Definition
Three different distance classes are identified in the Guidelines: short distance [0-300 km], with a subset below 100 km for urban; medium distance [300-1000 km] and long distance [1000 km and over].

Elaboration
Within the current document, the distinction of distance classes is made with reference to the policies

described in the European Commission 2011 White Paper on Transport.

In addition to the above-mentioned distance classes needed for the monitoring of the European transport policies, for the purpose of reporting of indicators by distance class, an additional split at 100 km has been included. This is done on the one hand to allow countries which currently can only provide indicators for this shortest distance class. On the other hand, it is done because differences in data collection protocols between countries often result in differences in the indicator for [100-300] km. It might therefore be relevant to handle this distance separately.

This definition of distance classes should not be mixed with distance bands at shorter distances (e.g. 0-2 km, 2-5 km, 5-10 km…) which can be used for e.g. analysing modal choices at different distances.

Mode (or mode of transport), mode by stage

Definition
Mode is defined as a vehicle or non-vehicle (such as walking) used for travelling.

Values for Mode
Different types of modes are used by the countries depending on their actual tradition. For the purpose of reporting Passenger Mobility indicators described in these Guidelines, all countries are asked to provide the same values of modal choice:

Passenger car as driver: this category includes driving a car (UN/ECE class M1, max 3.5 tonnes, max 8 passenger seats), regardless of the vehicle ownership.

Passenger car passenger: this category includes trips of respondents being driven as a passenger in a passenger car. *DriveNow*, *car2go* and similar services, as well as self-driving cars are included here. It does not include travelling as a passenger in a taxi or Uber service.

Taxi (as passenger): the category includes all trips as a paying customer with a professional driver or non-professional driver (including services like Uber). This mode refers to travel as a passenger only. Professional trips of transport professionals (Uber/ taxi/train/bus drivers) should not be included in the scope of the survey. Indeed, the Passenger Mobility survey does not aim to monitor the mobility of transport professionals. However all other trips by professionals such as commuting, shopping, when using their professional vehicles should be included. Taxi drivers using their taxi for other purposes than driving clients should report trips as driver of a passenger car.

Van/lorry/tractor etc: this category includes all non-professional trips, as passenger or as driver, in vehicles primarily intended for transport of freight (UNECE/EC classes N1, N2, N3)[2]. Professional trips transporting goods/freight, tools etc. are not included. In practice these types of vehicles can also be used by their drivers for other non-business related trips, especially for commuting. They are therefore included as a separate category (examples are builders, gardeners, etc). Tractors and similar vehicles should also be grouped under this category rather than in 'other'. Campers should be also included in this category.

Motorcycle/moped: this category includes all powered two-wheelers, three-wheelers, and quads, as well as snow-scooters and similar. Trips as professional e.g. as a police man or pizza delivery are not included.

Electric light scooters: privately owned or as a shared system

Bus/coach: this category contains all vehicles of UNECE class M2 and M3 designed to seat more than nine persons (including the driver), used primarily for the transport of passengers, including trolleybuses. Buses are vehicles of this type, normally designed to carry both standing and sitting passengers. Coaches are typically vehicles designed to carry only seated passengers. Trolleybuses are road vehicles connected to electric conductors but not rail-borne.

Metro/Tram/Light rail: Metro is a form of rapid mass transit, with high frequency and stops generally no more than 1000 m apart. Metro systems are generally separated from interactions with road vehicles.

[2] UNECE, Consolidated Resolution on the Construction of Vehicles (R.E.3) Revision 2, 2011

Trams, tramways or light rail systems are vehicles running on tracks often integrated in the urban road system or running in own tracé at ground level. They may go underground for shorter distances. They are usually electric but diesel-powered trams exist.

Train (split into High-speed Rail, Urban Rail, Regular/regional train): three subcategories of trains can be identified and in case they exist as such, the recommendation is to be reported separately:

- **High-speed train:** rail vehicles running mostly on both dedicated and upgraded high-speed railway lines, built to allow speeds of at least 250km/h and 200km/h respectively. Examples are TGV, Eurostar, ICE, etc.
- **Urban rail:** rapid transit with stops generally no more than 1200 m apart – examples include RER, S-Bahn, etc., but excluding metro and tram.
- **Regular/regional train**: all other rail-borne vehicles not included in the first two sub-categories.

Aviation (all): includes all types of airborne vehicles (e.g. airplanes, helicopters, balloons, dirigible airships, etc.), both public and private. Normally only passengers are included, however for small private airplanes the amateur pilot is also considered.

Waterways (all): includes both inland waterways (including rivers, lakes, and canals), ferries and maritime transport and all types of water-borne vehicles including cruise boats, ferries, motorboats, sailboats, rowing boats, etc. Professional sailors are excluded.

Walking: pure walking (incl. wheelchair, electric or not).

Cycling: all types of cycling, i.e. on bicycles privately owned or as a shared system (e-bike or not)

Other: this would include means such as 'Onewheel', 'Hoverboard' / 'Caster board', electric skates, electric skateboard, etc…

Countries using more detailed lists of travel modes are asked to group them into the above categories for purpose of reporting indicators. Countries not covering all of the above-mentioned categories at present are suggested to update their travel mode list on the occasion of future revisions of their national surveys in order to enable cross-country comparisons.

Elaboration
The list of modes is used for both stages and trips. Whether mode information is collected as stages or at trip level is influencing the travel distance per mode and the comparability of data across countries. Therefore the recommendation is that the travel mode information should be collected for each stage of a trip. Countries not yet having adapted their travel surveys to include trip stages are asked at least to provide the information on the main mode of travel used during each trip.

Modes not available in a country (e.g. metro or tram or high-speed train) may be excluded from the list.

For practical reasons, most surveys exclude short walking stages in combinations with other transport, when the impact on the total statistical picture is insignificant. It is recommended to formalise the exclusion as "less than 50 meters" or similar. Decision on this detail is left to the MS.

Main travel mode

Definition
Main travel mode is the travel mode within a trip which has been used for **the longest distance**.

Elaboration
The main mode is the mode, with the greatest distance sum for the entire trip. If the data contains a more detailed mode list, these subcategories should be aggregated before the length comparison. When two modes have equal distance (sum), the main mode is defined by the greatest travel speed.

As a result of the analysis of the Passenger Mobility Questionnaire and the information collected on different NTSs, it appears that the definition based on distance is the most often used definition and possible for common use.

A definition based on travel time might be attractive because travellers often remember travel time better than distance. A definition based on longest time spent on modes might however result in a bias to slow modes such as walking when this is combined with a bus or train ride.

Some countries use a main mode based on a prioritised list. But the choices are different from country to country and therefore not advisable for the purpose of comparing travel distance by mode between countries.

Fuel type

Definition
The type of fuel (energy carrier) used in a vehicle. This information is requested for passenger cars only.

Values of fuel type
The following list of values of fuel type should be used (for fuel that the vehicle uses):

- Petrol
- Diesel
- Petrol-electric, covers both non off-vehicle-chargeable hybrid electric vehicle ("Hybrid electric vehicle") and off-vehicle-chargeable hybrid electric vehicle ("Plug-in hybrid electric vehicle")[3]
- Diesel-electric, covers both non off-vehicle-chargeable hybrid electric vehicle ("Hybrid electric vehicle") and off-vehicle-chargeable hybrid electric vehicle ("Plug-in hybrid electric vehicle")
- Electric Vehicle (EV), covers pure electric vehicle ("Battery electric vehicle")
- Other, covers bi-fuel petrol/LPG, bi-fuel petrol/CNG, LPG, CNG, flex-fuel, other fuels than previously listed

In case some of the fuel-types are not available in the country (e.g. LPG or CNG) they can be left out. The list might change over the years if new technologies are emerging.

Elaboration
Different values can be suggested, depending on the level of detail required for policy analyses or national preferences. The category "other" contains the sum of all other fuel types that might be collected by the countries but are not included in the main listing. This category can be defined in detail by the individual countries taking into account the national relevance of different fuel types. It could include bi-fuel (petrol/LPG, petrol/CNG), bio-diesel, Ethanol/E-85, flex-fuel, etc. It is recommended only to use the value 'other' if it is subset by 'which?' In case the answer is a type which is already listed it is possible to correct the choice in the after-treatment or by the interviewer.

As a general approach towards suggesting a definition for fuel types, a rationale can be followed where a balance is found between identifying common denominators across countries (allowing for values of more detailed information) and presenting a level of detail for which data collection is considered feasible.

Contrary to other indicators the values for this variable may change over time, depending on the availability and success of future energy carriers.

[3] http://www.unece.org/fileadmin/DAM/trans/doc/2014/wp29/ECE-TRANS-WP29-2014-81e.pdf

Purpose (trip purpose, destination purpose, activity)

Definition
Travel **purpose** of a trip is the main activity at the destination of a trip.

Trip purpose is defined as the destination purpose for the trip. Trips which origin and destination are both home are considered as leisure.

Values for purpose
For the Purpose the following values are suggested to be used as a minimum list:

Work (commuting): Work/commuting is first of all trips to the workplace at the location of the respondent's employer. Attending e.g. a meeting outside the address of the company is a business trip. For employees working at e.g. a construction site for a long period, trips directly from home to the construction site are work/commuting trips too.

Professional / business: Trip related to work but not considered as commuting (meetings, etc).

Education: School or educational institution, school field trips, etc. The category covers when the respondent is a student/pupil, receiving teaching at the permanent education place or any other place on excursions etc.

Shopping: Shopping for groceries, non-daily shopping, shopping for other than groceries, etc.

Escorting: Picking up/accompanying/escorting people, taking children to school, bringing someone to the station, other drop off/pick up. Please be aware that 'escorting' should be used whenever respondents accompany somebody else somewhere; it includes taking children to and from school or kindergarten on their way to work and dropping off/picking up a someone on the way to/from work.

Leisure: Visiting friends/relatives, going out to eat or drink, touring/walking, sport/hobby, visiting vacation home, recreation at water/beach/mountains, cultural activities, entertainment, holiday, sightseeing, agro-tourism, voluntary work, private meetings, other leisure, etc. Loop trips are also included here.

Personal business: Services/personal care, health treatment, hair dresser, personal reasons, visiting a lawyer, religious activity, general errands (post office, bank, formalities, seeking for employment), bringing or picking up things etc.

Returning home: Trip where the origin is not home but the destination is home. Home is defined here as the primary residence (the dwelling where the person usually lives), secondary residence, occasional housing, hotel or other residence.

The term "home" is quite a subjective notion. Respondents may consider several addresses "home" (e.g. employed persons living in one city while working in another and consequently having two residences, or children from divorced parents who have two "homes".

Other: Other purpose

Elaboration
A journey consisting of only two trips (e.g. home-work-home) is simple to categorise: both trips have as purpose work. More complicated are trip-chains with two or more activities on top of work, e.g. home-work-shopping- escorting-home. When reporting travel purposes for trip chains it may be difficult to attribute a trip purpose. An example is to choose the main purpose of the journey and use this for all trips during the journey (e.g. to use the purpose with the longest stay). Another is to define some extra categories based on the trip-chain (e.g. work-shopping, work-leisure work-escorting, leisure-shopping as the most common). A third option is to add a category 'non-home based' (with the example home-work-shopping-home, work-shopping is a non-home based trip). However, this choice is little informative when the main purpose is used for getting an overview of the most important purpose for travelling.

In order to achieve comparability between countries, the purpose in the departure point of the home-bound trip to be the main purpose for that trip should be chosen. For all journeys with only one activity on top of home, this is the right choice. For the trip-chains, the choice of the purpose has to be based on the longest distance. In case of a loop starting and ending at the same place (often home) the purpose should be

leisure.

In theory, a high number of values for purposes can be identified. Indeed, many countries use much more extensive lists, which foresee separate categories for activities such as: visiting family or friends, going out to eat or drink, medical treatment, doing sports, food shopping, non-food shopping, etc.

Car occupancy

Definition

Car occupancy is defined as the number of persons in a passenger car by all ages, from babies to the oldest.

Elaboration

Contrary to the reference population which considers the age group 15-84 years, car occupancy should include children and the people aged over 85 too.

Calculation of car occupancy

The vehicle occupancy rate for passenger cars is calculated by dividing the total annual km declared for passenger cars as driver and as passenger, by the total annual vehicle km for passenger cars declared as driver, i.e. the following formula:

$$O_{car} = \frac{\sum_{i:car\ stage\ as\ passenger} w_i l_i + \sum_{i:car\ stage\ as\ driver} w_i l_i (1 + A_{not15-84,i})}{\sum_{i:car\ stage\ as\ driver} w_i l_i}$$

Where l_i is the stage length, w_i is the weight, $A_{not15\text{-}84}$ is the number of accompanying passengers outside the survey age group. Surveying the entire population without age limit would avoid collecting this information. This is why it is preferable to collect data without age limit.

Theoretically, it is possible to calculate the vehicle occupancy rate as the weighted (by mileage) average of the vehicle occupancy for trips with car as driver. Experience shows, that this approach provides unreliable results, due to biases in the reporting of the passenger counts and/or mileage. The preferred approach is to use pkm/vkm, as this approach eliminates these biases.

The pkm/vkm-based calculation of vehicle occupancy rate cannot be used, when the mode (as driver) is dominated by professional transport, which is excluded from the data. This applies especially to taxis, buses and lorries.

The vehicle occupancy rate has to be calculated at stage level. Indeed, data can be misleading when people only travel part of the total journey.

For taxis, the average vehicle occupancy (excl. driver) is estimated from the number of accompanying passengers. This can be done by the following formula:

$$O_{taxi} = \frac{\sum_{i:taxi\ stage} w_i l_i}{\sum_{i:taxi\ stage} \frac{w_i l_i}{(1 + A_{15-84,i})}}$$

Where O_{taxi} is estimated as the total taxi passenger mileage divided by the total taxi vehicle mileage. As it is not possible to calculate taxi vehicle mileage as driver mileage, this needs to be estimated, by dividing the mileage with the number of taxi passengers ($A_{15\text{-}84}$, which is the number of accompanying passengers within the survey age group + the respondent). l_i is the stage length, w_i is the weight. The formula excludes any passengers outside the survey age group (15-84). As far as other travel modes are concerned (such as buses and coaches, trams, metros or trains) it is clear that the NTS cannot provide information about the occupancy. It is therefore recommended to collect it directly from public transport companies.

2.3 Definitions related to medium- and long-distance travel with overnight stay

Section 2.3 includes definitions which should be used especially when surveying and reporting medium- and long-distance trips. It is only journeys with overnight stays for which an alternative definition is relevant. For medium- and long-distance same-day or one-day journeys the same terminology is used as for short-distance trips. Definitions which are the same for short-distance and long-distance trips are only repeated briefly in this section.

Reference population

Definition
The reference population for compilation of indicators should include **all country residents aged 15 to 84** inclusive.

Respondents

Definition
Respondents (net sample) are those among the original sample who actually **took part in the survey** and whose questionnaire is considered valid.

All days, per year

Definition
All days is all the days during the surveyed period weighted up to **a year.**

Elaboration
In retrospective survey respondents are asked for their trips during a reporting period, e.g. a month, 8 weeks or 3 months. As a result the distribution of respondents according to the number of trips they have undertaken during the reporting period (0, 1, 2, etc.) can be calculated. The number of trips and kilometres per person per year can be calculated by dividing the number/distance with the length of the reporting period and multiplying with 365 days.

Trip and Journey

Definition
A **trip** is the movement from an origin where the respondent has an activity to the destination where the respondent has (another) activity. The new activity can be the same kind of activity but with a different destination.

A **journey** is the sum of trips away from home and back home again, which could include at least one overnight stay.

The destination of a journey for a medium- or long-distance travel with overnight stay is the final destination.

Professional transport trips are excluded from the indicators.

Elaboration

For the purpose of comparing daily and long distance travel with one or more overnight stays, a journey could be divided into two trips, an outbound and a homebound. However, these two trips are not defined in the same way as a trip in a daily survey which goes from one activity to the next. The outbound or homebound 'trip' at longer distance is the entire way to the destination and might include sleeping. Therefore it is chosen not to ask for indicators for trips for the aggregated indicators for all distances. Accordingly, an indicator for travel time is not used either.

International journey: Only the outbound and homebound part of the journey should be included in an international journey. Trips at the final destination during the stay in a foreign country are not included in the journey. Only the trips between home and the final destination abroad are included. Data from tourism statistics (micro data) could also be used for passenger mobility indicators, if available. In case of doubt about where the final stay is, the location with the longest stay is chosen. If such one does not exist the location furthest away from home is chosen. With this choice not all travel activity and all kilometres are included in the aggregated reporting for all countries. It is generally burdensome and inaccurate to collect all trips made during a journey.

Stage

Definition

A **stage** is a movement making use of one transport mode, including any waiting time directly before or during the movement. A stage is defined by one single mode of transport.

If a change of mode of transport takes place, this means that another stage is initiated upon the change of transport modes.

Elaboration

It is recommended in the retrospective survey to ask for details of one journey; therefore all trips and stages during the journey should be included.

For air and train travel it is recommended to include change of air plane and change of train as new stages whereas a change from driver to passenger is not seen as a new stage.

Distance

Definition

Distance is defined as the length of the travelled track. Only distances on public areas, roads, paths, rails, sky and seaways are included.

Elaboration

For medium- and long-distance travel, information from the respondents about the travel distance is uncertain. It is therefore recommended to use a distance matrix between zones in one's own country and zones in the foreign country along roads and between airports. A rail distance matrix might also be used if the road distance is not considered to be representative.

Travel time and Duration of a journey

Definition

Travel time is the time spent travelling from the moment of departure from one activity to the moment of arrival at the new activity. The travel time includes the time spent waiting between two consecutive stages.

Duration of a journey is the number of nights spent from leaving home until returning home.

Elaboration

Travel time is only collected for a few journeys. In case of a round trip or a journey at which the respondent is using several days to arrive to the final destination, travel time should only be collected for one or a few journeys dependent of the need of the MS and the workload of the respondents.

Distance classes

Definition
Three different **distance classes** are identified in the current document: short distance (0-300 km), medium distance (301-1000 km) and long distance (over 1000 km).

Mode (or mode of transport), mode by stage

Definition
Mode is defined as a vehicle or non-vehicle, such as walking.

Values for Mode
For medium- and long-distance travel with overnight stay, a shorter list of modes is used.

Passenger car: this category includes driving a car (UN/ECE class M1, max. 3.5 tonnes, max. 8 passenger seats), regardless of the vehicle ownership.

Taxi is also included in the category for medium- and long-distance travel except when collecting information about stages at which a taxi is a typical access or egress mode for air and train travel.

Van/lorry/tractor, etc.: this category includes all non-professional trips, as passenger or as driver, in vehicles primarily intended for transport of freight (UNECE/EC classes N1, N2, N3)[4].

Motorcycle/moped: this category includes all powered two-wheelers, three-wheelers, and quads, as well as snow-scooters and similar.

Bus/coach: this category contains all vehicles of UNECE class M2 and M3 designed to seat more than nine persons (including the driver), used primarily for the transport of passengers. Coaches are typically vehicles designed to carry only seated passengers. It can both be private tour busses for leisure trips and public transport for medium-distance trips. Buses (vehicles designed to carry both standing and sitting passengers) and trolley-busses are normally only included as access and egress modes when registering stages.

Train (split into Total, High-speed trains and Regular trains): two subcategories of trains can be identified:

- **High-speed trains:** rail vehicles running mostly on both dedicated high-speed railway lines and upgraded conventional lines, built to allow speeds of at least 250km/h and 200 km/h respectively. Examples are TGV, Eurostar, ICE, etc.
- **Trains including regional trains and urban rail:** All other trains. When collecting information about stages access and egress modes, these can also be metro and light rail/tram.

Aviation (all): includes all types of airborne vehicles (e.g. airplanes, helicopters, balloons, dirigible airships, etc.), both public and private. Normally only passenger transport is included because travel by professional pilots is excluded. However, for small private airplanes, the amateur pilot should also be included.

Waterways (all): includes both inland waterways (including rivers, lakes, and canals), ferries and maritime transport and all types of water-borne vehicles, including cruise ships, ferries, motorboats, sailboats, rowing boats, etc.

Cycling, walking, other: this category covers all kinds of bicycles, walking, horseback, and horse carriage

[4] UNECE, Consolidated Resolution on the Construction of Vehicles (R.E.3) Revision 2, 2011

are included too even though these modes are not very common for long distance travel.

Elaboration
The exclusion of professional transport implies that certain mode/driver combinations are likely to be rare; this applies to e.g. bus as driver and lorry as driver.

Countries using more detailed lists of travel modes are asked to group them into the above categories for the purpose of reporting medium- and long-distance travel.

Main travel mode

Definition
The main travel mode is the travel mode within a journey which has been used for **the longest distance**.

Travel Purpose

Definition
The **purpose** of a journey is the main reason for a journey.

Values of purposes
Professional/business purpose: Business in course of work, trade, employee business, education as part of a position, commuting to a workplace so far away that a place to stay at the destination is needed.
Private purpose: This category includes all purposes that are not professional.

Elaboration
For medium- and long-distance travel, when reporting indicators, only the two categories of purposes, private and professional/business are asked for.

Accompanying travellers and Car occupancy

Definition
Accompanying travellers are persons travelling together with the respondent. For cars and taxis, the figure covers other persons in the same vehicle.

Car occupancy is the average number of persons per car. The car occupancy is only calculated for passenger cars.

Calculation of car occupancy
As for the urban and short distance mobility, the car occupancy should be calculated as the total distance made by all passenger and all drivers divided by the total distance made by all cars, if possible. This requires reporting of driver/passenger for all stages and reporting of accompanying passengers outside the survey age group.

This can be done by the following formula:

$$O_{car} = \frac{\sum_{i:car\ stage\ as\ passenger} w_i l_i + \sum_{i:car\ stage\ as\ driver} w_i l_i (1 + A_{not15-84,i})}{\sum_{i:car\ stage\ as\ driver} w_i l_i}$$

Where l_i is the stage length, w_i is the weight, $A_{not15\text{-}84}$ is the number of accompanying passengers outside the survey age group.

If the driver/passenger distinction is not available, the car occupancy should be estimated from the number

of accompanying persons.

This can be done by the following formula:

$$O_{car} = \frac{\sum_{i:car\ stage} w_i l_i}{\sum_{i:car\ stage} \frac{w_i l_i}{(1 + A_{15-84,i})}}$$

Where O_{car} is estimated as the total car passenger+driver mileage divided by the total car mileage. As it is not possible to calculate car mileage as driver mileage, this needs to be estimated, by dividing the mileage with the number of passengers ($A_{15\text{-}84}$, which is the number of accompanying passengers within the survey age group + 1 =the respondent). l_i is the stage length, w_i is the weight. The formula excludes any passengers outside the survey age group (15-84).

There is no need to calculate separate occupancy rates: one when the respondent was the driver of the car, and another when the respondent was a passenger. A single rate is needed, but there may be a vehicle occupancy rate for passenger cars and a separate one for taxis.

Elaboration
The concept of accompanying travelers may be generalised to the other modes, supporting national data needs. For public transport, this requires a definition, where people are only regarded as accompanying travelers, if they intended to travel together.

2.4 Specific terminology: “urban area” and “urban mobility”

In this section, an overview of the definition of “urban area” is given and the use of the definition for reporting indicators for urban and non-urban travel is presented.

Definition of Urban area

The “Urban area” is defined as the FUA commuting zone in the EC-OECD definition of Functional Urban Areas.

Elaboration
Different definitions for urban area and urban mobility have been considered and both the Task Force and the Member States have been consulted on which solution would fit best to be used for reporting urban and non-urban trips. As a result of this process (incl. feedback received from countries through the Passenger Mobility Questionnaire), it was decided to make use of the new EC-OECD definition of Functional Urban Areas (FUA). FUA consists of a "city" and its "commuting zone".

See also:

http://ec.europa.eu/eurostat/statistics-explained/index.php/European_cities_%E2%80%93_the_EU-OECD_functional_urban_area_definition
http://ec.europa.eu/regional_policy/sources/docgener/focus/2012_01_city.pdf
http://www.oecd.org/gov/regional-policy/functionalurbanareasbycountry.htm
The list of FUAs country-by-country is available on http://ec.europa.eu/eurostat/web/metropolitan-regions/overview (see Annex 1)
For more details on the definitions, please consult: http://ec.europa.eu/eurostat/web/cities/spatial-units

The definition of the "commuting zone" is mainly based on municipalities or similar administrative areas (LAU 1). However, for some countries smaller administrative areas (LAU 2) are used for definition of commuting zones, which means that the border of the FUA is not completely following the municipality borders. In these cases the definition based on LAU 2 might not be applicable for the NTS. This could be

the case if the definition of the destination zones in the NTS is based on municipalities or on traffic zones which are not comparable with the LAU 2 zones. In Denmark for instance, LAU 2 is defined as parishes which are not comparable with the traffic zones at a lower level than the municipality. If the organisation that conducts the NTS faces such problems with the definition of the FUA, it might be an option to consult the NSI for an adaption of the FUA borders to a more usable version based on e.g. municipalities/LAU 1.

Values of urban areas

The greater urban zones can be divided into 4 types of zones according to the overall population in the zones:

- Large metropolitan area, population of 1.5 million or more
- Metropolitan area, population between 500 000 and 1.5 million
- Medium-sized urban area, population between 200 000 and 500 000
- Small urban area, population below 200 000.

The most important *advantages* of this definition are the following:

- The definition is following administrative borders allowing clarifying if destinations identified by either addresses or coordinates are inside or outside an urban area. It is furthermore possible to produce a map for online search of destinations.
- When detailed origin-destination information is available, the defined urban areas allows for a clear identification of urban and rural areas. As a result, a direct link with urban mobility can be achieved.
- Integration of a transport concept (i.e. commuting zone) in the definition of a FUA vs. a non-urban area is a relevant context. This may assist in linking the concept of FUA with urban mobility.
- The new methodology of classifying urban and non-urban areas is being used by different Directorate-Generals (DGs) and Eurostat. As such, it will enhance comparability of projects related to urban mobility across the different DGs.

The most important *disadvantage* of the definition is the following:

- As with all other identifications of places it is not easy for the respondent to define the exact location when he/she does not know the address and a map is not available. Administrative borders are furthermore not easy to know for people, especially not for non-locals.

Urban and non-urban mobility

Definition

Urban mobility: Trips made by residents of an urban area, where both origin and destination are inside the same urban area.

Non-urban Mobility*: Any trips made by respondents living outside the urban area or where at least one endpoint is outside the urban area*

Urban mobility is defined as 'local' mobility of urban residents. 'Local' here should be understood as the proximity of the respondent's residence, or ideally the urban area in which the respondent lives. This approach is a pragmatic approximation for measuring urban mobility, in case origin and destination of the trip are not known, and therefore all is based on residency of the respondent. A further refinement of this approach could include a distance threshold of 100 km, for instance, which would reduce errors from potential movements of urban residents outside urban areas. However one cut-off value may not be applicable for all urban centres; therefore countries are asked to internally evaluate what is appropriate for specific situations and urban area size.

All mobility that is not considered urban should be categorised as non-urban.

Possible alternative definitions

Several urban and non-urban alternatives could be defined. One option is that trips made by inhabitants living outside a FUA are urban if they are made fully inside a FUA. Another option is to consider as urban mobility trips with one end inside the FUA but the other end outside.

Elaboration

By defining urban mobility by residency of the respondent, kilometres performed inside the urban area made by respondents living outside may be missed if the origin and the destination are not known. One solution to cover this segment of travellers is using precise geocoding of all trips and a route programme to calculate the share of each trip inside and outside the urban zone.

Methods to identify the location of a trip

To be able to report all urban mobility, the residence of the respondent and the origin and destination of each trip is needed. In most NTSs, the residence address is known from sampling. If sampling is based on e.g. telephone registers, this information should be asked. Different methods for identifying the destination locations are available and described below.

Exact identification of the localisation of a destination: The precise geocoding of origin/destination information through address or GNSS positioning is of course the most precise solution and provides for the use of data for other spatial analyses, e.g. transport modelling. The home address is normally known and confirmed at the beginning of the interview. A question about the address of a workplace or school is also a recommended as background information at the beginning of the interview. In this way, more than half of all origin/destinations are known. During the interview the address of many other places, such as visits, sports clubs etc. can be reported. In case a file with a register with addresses of shops, companies, public institutions etc. can be obtained from a public or private body, it is recommended to load it and make the list available for searching. If lists of addresses and the corresponding geocodes are not available from a public body, a list can be obtained from Google which also updates the information.

Box 1 Address identification in Denmark

In Denmark, lists of both postal addresses and of companies and institutions are publicly available and loaded regularly into the NTS address database. The NTS address database is updated every time a new shop, public institution or company is identified by an interview. The original list missed many addresses of public institutions such as schools and kindergartens and private addresses of certain shops. However, most are included today. In case the location is not identified during the interview this is done in the after-treatment procedures.

A special problem represents leisure trips into the nature, a park, a beach, etc. Little by little, geocodes have been added to cover such places as to identify the destination zone. These proceedings have led to an identification of over 96% of all addresses during the interview, and more than 99% at a distance less than 100 m from the correct address following the after-treatment (when only municipality is needed the missing locations are less than 0.1%).

Identification of the localisation of destinations at aggregate zone level: To identify FUA and the municipalities, it is recommended to ask for the address even though only a more comprehensive zone-number or municipality end up with being registered in the database. In cases where an address cannot be identified a solution may consist in asking for the name of the village / town / city of the destination. With a list of all towns/villages in the country and the municipality they belong to, the method can be quite effective for searching. This solution is also useful in case of a paper-and-pencil interview for which searching through a register is not possible.

Identification of the localisation of destinations from existing NTS: In case no precise destination localisation exists except for the home address, urban mobility can only be estimated. Trips with an origin or destination at home can be identified as urban if the home address is in the FUA and the trip is shorter than a certain threshold, depending on the Urban Centre size. If the respondent lives in a rural area, all his/her trips are considered as rural trips. An example of a list of trip-distance thresholds could be:

- City size 50 000 – 100 000 : 10 km
- City size 100 000 – 250 000 : 15 km
- City size 250 000 – 500 000 : 30 km
- City size 500 000 – 1 000 000 : 50 km
- City size 1 000 000 – 5 000 000 : 70 km
- City size >5 000 000 : 80 km

The list **has to be corrected by analyses based on existing NTSs** with good spatial information (distances mentioned do not correspond to actual cities and are just meant as examples). The list can furthermore be improved by taking into account if the respondent lives in a core city area or in its hinterland. The method can be used too when respondents deny giving any spatial information at all. In case no home address exists, post-processing of urban mobility is impossible.

For new surveys the use of precise geocoding of origin/destination information or an appropriate zone coding is clearly the preferred solution. For countries which would have trouble implementing this, coding based on coded home address combined with questions about the name of the village/town/city of the destination is an acceptable practice to identify urban vs non-urban mobility.

Elaboration
The definition of urban mobility is aiming at capturing all trips made within a FUA by the entire mobile population living inside and outside a city. In a few countries and in some of the oldest surveys geographical information about trip destinations are not included. Most of them (but not all) have information about the location of the residence of the respondents. For these surveys a definition focused on 'local' mobility of urban residents is chosen. 'Local' should be understood as the proximity of the respondent's residence, or ideally the urban area in which the respondent lives. This approach is a pragmatic approximation for measuring urban mobility in case origin and destination of the trip are not known. The distance threshold of 100 km could be an option for defining 'local'. However, this distance might be too long for small urban centres and in general a common cut-off value may not be applicable for all urban centres. Therefore, countries are asked to internally evaluate what is appropriate for specific situations and urban area size.

2.5 Quality and mobility indicators

This chapter contains recommendations on a harmonised set of indicators on passenger mobility, which are most relevant for the monitoring of the EU transport policy needs. The indicators will serve as a basis for the tables that are used by countries to report passenger mobility statistics (see Chapter 3). This does not mean that countries need to limit themselves to these parameters or indicators when collecting data or performing data analyses. Countries can obviously add elements to this list according to individual requirements or the monitoring of national policies.

The set of indicators on passenger mobility described in this chapter is the result of findings stemming from a long-term European experience in collecting and analysing National Travel Surveys with the purpose of understanding passenger mobility. From these projects, more practical knowledge on good practices and experiences with data collection led to the identification of a wide range of practically relevant parameters and indicators, as also reported by the SHANTI action (Armoogum et al., 2014).

The indicators to be provided are indicators on survey quality and indicators on passenger mobility. Some of the indicators are described in section 2.2. The rest is defined below.

2.5.1 QUALITY INDICATORS

Sample size

Definition
The sample size is given by the number of persons/households selected for interview.

Number of respondents

Definition
Number of respondents is the number of persons/households who have finished the interview and whose questionnaire is accepted in the post processing.

Elaboration
The indicator for the number of respondents has to be stated in absolute number, i.e. not up-weighted to the population size.

The questionnaires ought to be checked in an after-treatment process. Interviews which are subject to irreparable errors which will compromise the calculation of indicators should be left out of the database.

The absolute number of respondents is an important indicator on the precision of the final result.

Response rate

Definition
The response rate is the number of respondents divided by the number of sampled persons/households, reported as a percentage.

Non-response rate is 100% minus the response rate.

Values for non-response rate
In case the respondents can only or mainly be contacted for an interview by telephone, the share of non-response should be divided into the share with missing telephone numbers and others.

Elaboration
The response rate reported has to be calculated in a homogeneous way from all surveys.

If a country is replacing sampled people who do not participate with other people in a similar group (e.g. with same age, gender, geographical area, household size) from a secondary sample, the final number of respondents is increased. This is for instance the case for Poland. However, the response rate has to be calculated as the respondents from the original group divided by the number in the basic sample. If the response rate is calculated as the final number of respondents divided by the basic sample, then the sample will be far too high. A response rate where the final number of respondents is divided by the contacted number of persons from the two samples will probably be too low because the respondents who have been needed to contact from the secondary sample will be people with a lower response rate than the average.

The number of respondents without known telephone number is relevant to be known if the sample is drawn from an address-based register and the interview is conducted as CATI or if the main or only contact to the respondents is made by telephone. In case of mailed questionnaires or follow up by personal interview, the telephone number is of less need.

Reference population (absolute number)

Definition
The **reference populatio**n for the compilation of indicators should include **all country residents aged 15 to 84 inclusive** (see Section 2.2).

Share of trip-makers among respondents (%)

Definition
Share of respondents who have made a trip at the actual day reported in percent (see Section 2.2).

Elaboration
The share of trip-makers is only relevant for the cross-sectional survey.

Absolute number of trips or journeys

For definition of a trip, see Section 2.2.

For definition of a journey, see Section 2.3.

Elaboration
The number of trips/journeys is an important indicator for the precision of the results reported in the tables. It is reported in the tables with the travel-related indicators.

2.5.2 PASSENGER MOBILITY INDICATORS

Travel distance per person per day

Definition
Weighted travel distance in kilometres divided by the weighted number of respondents on the actual day.

Calculation of weighted travel distance per person per day
The weighted kilometres per person per day are calculated by summarising all respondents' kilometres multiplied by the "weight" of the respondent and divided by the weighted sum of respondents. This is done for all respondents and separately for respondents answering at working days and non-working days, respectively. For a multi-day survey these results have to be divided by the number of days surveyed (for a 7-days survey the numbers are divided by 7). In case of a survey period shorter than a year the passenger kilometres have to be up-weighted to a year.

Number of trips per person per day

Definition
Weighted number of trips divided by the weighted number of respondents on the actual day.

Trips per person per day are calculated similar to the distance by replacing kilometres by 1 (for one trip).

Travel time per person per day

Definition
Weighted travel time in minutes including waiting time divided by the weighted number of respondents on the actual day.

Travel time per person per day is calculated similar to the distance by replacing kilometres by minutes for each trip (including waiting time).

Passenger kilometres for all reference population per year

Definition
Passenger kilometres are calculated as the total weighted travel distance in kilometres made by all persons within the reference population in a reference year.

Vehicle occupancy rate

Definition
Vehicle occupancy rate is the average number of persons travelling in a passenger vehicle on a reference year.

It is recommended to provide vehicle occupancy for passenger cars and taxies for all age groups and not only for age group 15-84 years.

Elaboration
The calculation of the vehicle occupancy rate for passenger cars and taxies is described in Chapter 2.2. All calculations should be made on data weighted by the respondent. In order to obtain results for the entire population (all age groups) it is necessary to complement the calculation above with additional information from all car drivers on the number of trip companions to be asked for each stage of a trip. It is necessary to make a distinction between age groups that are covered by the reference population and those that are not (e.g. below 15 years, between 15 and 84 years, and 85 years and above). In case of a taxi trip all respondents are asked the same question.

As far as other travel modes are concerned (such as buses and coaches, trams, metro or trains) it is clear that the NTS cannot provide such information. It is therefore recommended to collect the information directly from public transport companies if possible.

Number of journeys per person per year

Definition
Weighted number of journeys divided by the weighted number of respondents on the actual day.

Elaboration
For travel with overnight stay(s) travel information is collected for journeys.

For all retrospective surveys the indicators are calculated per year.

Average duration per journey

Definition
Average duration per journey is the weighted average of the number of nights.

Elaboration
For journeys with overnight stay(s) the travel time is not stated. Instead, the number of nights is collected which should be considered as average duration of the journeys (in days). The average duration is calculated by summarising the number of nights for a journey multiplied by the person "weight", and then divided by the weighted number of journeys.

3. Recommendations on a harmonised set of passenger mobility indicators

This chapter presents tables with indicators which all EU Member States and candidate countries should aim for when reporting on a regular basis.

3.1 Introduction

An important purpose for collecting a harmonised set of indicators is to be able to follow the development in relation to objectives stated in the European Commission 2011 Transport White Paper, especially:

- Halve the use of 'conventionally-fuelled' cars in urban transport by 2030;
- By 2050 the majority of medium-distance passenger transport should go by rail.

The tables with indicators on passenger mobility are based on the indicators defined in Chapter 2.5. They are inspired by the findings stemming from the European COST action SHANTI in the domain of passenger mobility statistics. To produce the recommended tables, a National Travel Survey is considered as the main data collection tool.

The harmonised set of indicators and the listed tables should be considered as a means to monitor and evaluate the development in passenger mobility by individual countries for:

- Urban and non-urban passenger mobility
- Short distance (0 to 300 km), medium distance (301 to 1000 km) and long distance (above 1000 km)

The tables for short-distance passenger mobility indicators should be provided with the following distinctions in mind:

- Distance class ranging from 0 to 300 km
- Mobility type for trips up to 100 km: Urban mobility and non-urban mobility
- Travel day: Working days and non-working days

The tables for medium- and long-distance travel should be provided for:

- One-day journeys
- Journeys with overnight stay

Due to the different nature of short-distance trips compared to medium- and long-distance journeys, the indicators to be provided are presented in the two different sections further below; Section 3.2 for the short distances and Section 3.3 for medium and long distances.

The main reason for the distinction is that short-distance trips are collected by a daily NTS (in the following called a cross-sectional survey) while journeys with overnight stay(s) and other medium- and long-distance trips are so infrequent that a retrospective survey is needed to obtain indicators at an acceptable level of certainty. These different types of surveys may better be explained and reported independently. The methodological differences in collecting a cross-sectional and a retrospective survey are presented in Sections 4.5 and 4.6.

An overview of the indicators and the associated breakdown variables is presented in

Table 1. The set of indicators is based on definitions, terminologies and breakdowns of the variables outlined in Chapter 2. For monitoring passenger mobility by mobility type (urban, non-urban, total) it has been decided to limit the maximum trip distance to 100 km. Indicators relating to distance classes should be calculated per year and per journey (Indicator 3) and without additional distinction by type of day. Additional indicators and/or breakdown variables may be interesting for individual countries.

Table 1: Overview of the harmonised set of passenger mobility indicators

	Key indicator	Preferential breakdown variables	
		Short distance	Medium and long distance
1.	Survey Quality Indicators	Sample size Reference population Survey response rate Net sample (Respondents) Share of trip-makers Number of Trips	Sample size Reference population Survey response rate Net sample (Respondents) Number of Journeys
2.	Number of trips / journeys per person	Number of trips per person per day By urban/non-urban By main travel mode By travel purpose	Number of journeys per person per year By distance class By main travel mode By travel purpose
3.	Travel distance per person	Total distance per person per day By urban/non-urban By working day/Non-working day By travel mode By fuel type (for passenger cars) By travel purpose	Total distance per person per year By travel mode By fuel type (for passenger cars) By travel purpose
4.	Travel time	Total travel time per person per day By urban/non-urban By working day/Non-working day By travel mode By travel purpose	Total number of overnight stays
5.	Passenger kilometres for reference population - per year	Total kilometres By urban/non-urban By working day/Non-working day By travel mode By fuel type (for passenger cars) By travel purpose	Total kilometres By travel mode By fuel type (for passenger cars) By travel purpose
6.	Average vehicle occupancy rate - For passenger cars - For taxies	By urban/non-urban By working day/Non-working day	For passenger cars and taxies

The number and structure of the indicators to be reported for the purpose of monitoring passenger mobility by distance classes and by type of mobility (

Table 1) have been harmonised to a great extent. They should be based on the same total reference population, limited to age group 15-84 inclusive in order to enhance comparability of results across Europe. All passenger mobility indicators to be provided should be calculated based on weighted data.

The indicators for urban mobility have to be calculated based on the whole reference population. Even though only trips made by inhabitants in the urban area are included, the number of trips and kilometres has to be divided by the weighted number of all respondents interviewed on the actual day.

3.2 Passenger mobility indicators for urban and short

distance

Short-distance daily trips are subdivided into trips of 0-100 km and of 101-300 km to improve reliability and comparability of results, because many countries are not able to provide reliable data for distances over 100 km based on a cross-sectional daily mobility survey. Then the maximum trip distance for trips to be included under urban mobility will in most cases be much shorter than 100 km, as explained in Chapter 2.4. A cut-off distance at 100 km is used for urban trips and will enable all countries to provide this information in a comparable way.

Calculation example for the number of trips per person per day

Where

$w_{i,d}$: the weight of the individual i that replies for the day d (d could be one of the following day: Monday or Tuesday or …. Friday or Saturday or Sunday)

- i is the i[th] individual that belong to the respondent sample
- d: day (Monday or Tuesday or …. Friday or Saturday or Sunday (bank holiday should be considered as a Sunday))

$t_{i,u,d,m,p}$: Number of trips made by the individual i that living in localisation u, on the day d, with mode m and for the purpose p

- u: type of localization (Urban mobility or Total mobility)
- m: mode (car as driver; car as passenger; taxi (as passenger); van/lorry/tractor/camper; motorcycle and moped; bus and coach; train; aviation; waterways; cycling; walking; other)
- p: purpose (work; professional/business; education; shopping; escorting; leisure; personal business)

Note: $t_{i,d,m,p,u}$ is equal to 0; 1; 2 … (e.g. 1: if the individual i makes one trip on the day d with mode m and for the purpose p)

For: Number of trips per person/day (working day and Urban mobility <100Km): $M_{\substack{d=Monday\ to\ Friday \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=Monday\ to\ Friday \\ u=\text{Urban mobility}}} = \frac{\sum_{\substack{i\in r \\ d=Monday\ to\ Friday}} \sum_{\substack{i\in r \\ d=Monday\ to\ Friday \\ u=\text{Urban mobility} \\ m=all \\ p=all}} w_{i,d} * t_{i,u,d,m,p}}{\sum_{\substack{i\in r \\ d=Monday\ to\ Friday}} w_{i,d}}$$

For: Number of trips per person/day (Saturday and Urban mobility <100Km): $M_{\substack{d=Saturday \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=Saturday \\ u=\text{Urban mobility}}} = \frac{\sum_{\substack{i\in r \\ d=Saturday}} \sum_{\substack{i\in r \\ d=Saturday \\ u=\text{Urban mobility} \\ m=all \\ p=all}} w_{i,d} * t_{i,u,d,m,p}}{\sum_{\substack{i\in r \\ d=Saturday}} w_{i,d}}$$

For : Number of trips per person/day (Sunday and Urban mobility <100Km): $M_{\substack{d=Sunday \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=Sunday \\ u=\text{Urban mobility}}} = \frac{\sum_{\substack{i\in r \\ d=Saturday}} \sum_{\substack{i\in r \\ d=Sunday \\ u=\text{Urban mobility} \\ m=all \\ p=all}} w_{i,d} * t_{i,u,d,m,p}}{\sum_{\substack{i\in r \\ d=Sunday}} w_{i,d}}$$

For: Number of trips per person/day (Non-working day and Urban mobility <100Km): $M_{\substack{d=\text{Non-working day} \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=\text{Non-working day} \\ u=\text{Urban mobility}}} = \frac{1}{(number\ of\ non-working\ day)} \left(M_{\substack{d=satday \\ u=\text{Urban mobility}}} + M_{\substack{d=Sunday \\ u=\text{Urban mobility}}} \right)$$

Note: that the number of non-working days is generally 2 (unless there is a bank holiday).

For: Number of trips per person/day (all day and Urban mobility <100Km): $M_{\substack{d=\text{all day}\\u=\text{Urban mobility}}}$

$$M_{\substack{d=all\ \text{day}\\u=\text{Urban mobility}}} = \frac{1}{365}\left(number\ of\ working\ day * M_{\substack{d=Monday\ to\ Friday\\u=\text{Urban mobility}}} + number\ of\ saturday * M_{\substack{d=satday\\u=\text{Urban mobility}}} + number\ of\ sunday * M_{\substack{d=Sunday\\u=\text{Urban mobility}}}\right)$$

Example of SAS programme to compute the number of trips per person/day (working day and Urban mobility <100Km).

It is assumed that the data architecture is as follows: a file TRIP describing all the trips (with m: mode, p: purpose, ...) and a file PERSON describing the individuals (u: type of localisation, d: day under-review, w: weight of the individual,. ...)

```
Data TRIP; set TRIP; trip=1;
Proc means data=trip nway noprint;
Class person_number ;
Outout out=RES_MOB SUM=Number_of_trip; run;
Data PERSON set PERSON;
Proc sort ; by person_number ;
Data PERSON; merge PERSON RES_MOB ; by person_number ;
If w ne . ;
If Number_of_trip =. Then Number_of_trip=0;
proc means data= PERSON noprint;
var Number_of_trip ;
weight w ;
where u=" urban mobility"; where d in ("Monday", "Tuesday", "Wednesday", "Thursday", "Friday");
output out=MOB_UM_WD  mean= ; run;
```

Table 2: Passenger mobility indicators by type of mobility (urban, total) and type of day (working/ non-working day / all days)

Passenger mobility indicators by type of mobility: urban, total short distance and days of the week: working day, non-working day	**Working day**		**Non-working day**		**All days**	
	Urban mobility <100Km	**Total mobility <300Km**	**Urban mobility <100Km**	**Total mobility <300Km**	**Urban mobility <100Km**	**Total mobility <300Km**
1. Survey quality indicators						
a) Sample size						
b) Reference population[5] (absolute number)						
c1) Response rate (Households) (%)						
c2) Response rate (Individuals) (%)						

[5] All indicators should be compiled for the age group 15-84 (inclusive).

d) Number of respondents						
e) Share of trip-makers[6] among respondents (%)						
f) Number of trips						
2. Number of trips per person[7]/per day						
a) Total						
b) By main travel mode[8]						
By passenger car (total)						
as driver						
as passenger						
By taxi (as passenger)						
By van/lorry/tractor/camper						
By motorcycle and moped						
By bus and coach						
By train (total)						
High-speed train						
Regular train						
Urban rail						
Aviation						
Waterways						
Cycling						
Walking						
Other						
c) By travel purpose						
Work (commuting)						
Professional/ business						
Education						
Shopping						

[6] See definition in Chapter 2.

[7] All indicators should be compiled per respondent and calculations have to be performed on weighted data.

[8] Main mode = travel mode with the longest distance; see definition of what should be grouped under each travel mode in Chapter 2.

Escorting						
Leisure						
Personal business						
Other						
3. ***Travel distance per person/day (km)***						
a) Total						
b) By travel mode[9]						
By passenger car (total)						
as driver						
as passenger						
By taxi (as passenger)						
By van/lorry/tractor/camper						
By motorcycle and moped						
By bus and coach						
By train (total)						
High-speed train						
Regular train						
Urban rail						
Aviation						
Waterways						
Cycling						
Walking						
Other						
c) By fuel type (passenger car)						
Petrol						
Diesel						
Petrol electric						
Diesel electric						
Electric vehicle (E.V)						
LPG						

[9] Based on all stages of a trip; countries not yet collecting stages can provide it based on main travel mode in which case all distance of a given trip is allocated to the main mode used for that trip.

CNG						
Hydrogen						
Other/unknown						
d) By travel purpose						
Work (commuting)						
Professional						
Education						
Shopping						
Escorting						
Leisure						
Personal business						
Other						
4. Travel time per person/day (minutes)						
a) Total						
b) By travel mode[10]						
By passenger car (total)						
as driver						
as passenger						
By taxi (as passenger)						
By van/ lorry/tractor/camper						
By motorcycle and moped						
By bus and coach						
By train (total)						
High-speed train						
Regular train						
Urban rail						
Aviation						
Waterways						
Cycling						
Walking						

[10] Based on all stages of a trip; countries not yet collecting stages can provide it based on main travel mode in which case all travel time of a given trip is allocated to the main mode used for that trip.

Other						
c) By travel purpose						
Work (commuting)						
Professional						
Education						
Escorting						
Shopping						
Leisure						
Personal business						
Other						
5. Passenger kilometres (pkm) for all reference population/ year						
a) Total						
b) By travel mode[11]						
By passenger car (total)						
as driver						
as passenger						
By taxi (as passenger)						
By van/ lorry/tractor/camper						
By motorcycle and moped						
By bus and coach						
By train (total)						
High-speed train						
Regular train						
Urban rail						
Aviation						
Waterways						
Cycling						
Walking						
Other						

[11] Based on all stages of a trip; countries not yet collecting stages can provide it based on main travel mode in which case all distance of a given trip is allocated to the main mode used for that trip.

c) By fuel type (passenger car) as a driver						
Petrol						
Diesel						
Petrol electric						
Diesel electric						
Electric vehicle (E.V.)						
LPG						
CNG						
Hydrogen						
Other/unknown						
d) By travel purpose						
Work (commuting)						
Professional						
Education						
Shopping						
Escorting						
Leisure						
Personal business						
Other						
6. Average vehicle occupancy						
For passenger car						
For taxi						

The indicators presented in Table 2 can also be used for collecting non-urban mobility for distances under 100km.

How to elaborate the indicators “Passenger kilometres (pkm) for all reference population/ year”=PKY:

1) An easy way would be to take the “Travel distance per person/day (km)” for “all days” * 365 * “the size of the reference population (between 15-84)”
2) A formal way would be :
   a. PKWD=“Travel distance per person/day (km)” for “Working Day” * number of working day * “the size of the reference population (between 15-84)”
   b. PKS=“Travel distance per person/day (km)” for “Non-Working Day” * number of Saturday * “the size of the reference population (between 15-84)”
   c. PKSBH=“Travel distance per person/day (km)” for “Non-Working Day” * number of (Sunday + bank holiday) * “the size of the reference population (between 15-84)”

   Then PKY= PKYWD + PKYS + PKYSBH

Reasonable figures for indicators on the basis of international experience:

- A working day should show around 3.3 trips per day and per person
- A non-working day should show around 2.0 trips per day and per person.

There difference between “Urban mobility” and “Total mobility” should not be too large.

3.3 Passenger mobility indicators for medium and long distance

Passenger mobility indicators should be provided for the following distance classes:

- medium distance: from 300 to 1000 km
- long distance: over 1000 km

Unlike the table by type of mobility, the indicators by distance classes are likely to be based on different types of surveys depending on the distance class and on the national practice.

For the urban and short distance (<300 km) all countries provide results based on their national daily mobility survey which is either a one day or a multiday survey (e.g. 7 days in case of UK and the German MOP). However, those surveys often have a cut-off limit for the maximum trip distances covered, varying greatly between the countries. Furthermore, the longer the travel distance, the less frequent the trip is. Trips longer than 100 km are less frequent than shorter trips and trips over 300 km are not so often made as a one-day travel without an overnight stay. In any case, they are too few to be collected with an acceptable level of certainty in a cross-sectional/daily survey, even though surveys with a very high number of respondents. Also, respondents with many long distance trips with overnight stays are more difficult to contact during the data collection period and the resulting data on multiday-trips are too biased.

To be able to monitor the low frequency journeys correctly, a dedicated retrospective survey is needed. It will usually cover a reference period from 1 to 3 months, dependent on the size of the sample, the data reference period and the importance of a memory recall effect. It can either be collected by the end of the daily NTS or as a separate survey. This choice depends on the data collection method (e.g. CATI or CAPI), the length of the daily questionnaire (risk for too many interrupted interviews due to response fatigue) and the data collection period (the shorter the period the more respondents with frequent long distance travelling are lost). Please refer to Chapter 4

In this section **only indicators resulting from a retrospective survey are reported**. In case the cross-sectional / daily survey includes the relevant indicator, this is reported by the indicators outlined in Section 3.2.

Table 3: Passenger mobility indicators by distance classes (medium and long distance: 301-999 km, 1000 km and above)

Passenger mobility indicators by distance classes	Medium-distance mobility		Long-distance mobility	
	One-day	Overnight	One-day	Overnight
1. Survey quality indicators				
a)Survey type + survey period + data collection period				
b) Sample size				
c) Reference population[12]				
d1) Response rate (households)				
d2) Response rate (individuals)				

[12] All indicators should be compiled for the age group 15-84 (inclusive).

e) Number of respondents				
f) Share of trip-makers[13] among respondents (%)				
g) Number of journeys				
2. Number of journeys per person[14]/ per year				
a) Total				
b) By main travel mode[15]				
By passenger car (total)				
By van/camper				
By motorcycle and moped				
By bus and coach				
By train (total)				
High-speed train				
Regular train				
Urban rail				
Aviation				
Waterways				
Cycling, Walking, Other				
c) By travel purpose				
Professional				
Personal				
3. Travel distance per person per year Average distance per journey				
a) Total				
b) By travel mode[16]				
By passenger car (total)				
By van/camper				
By motorcycle and moped				
By bus and coach				

[13] See definition in Chapter 2.

[14] All indicators should be compiled per respondent and calculations have to be done on weighted data.

[15] Main mode = travel mode with the longest distance; see definition of what should be grouped under each travel mode in Chapter 2.

[16] Based on all stages of a trip; countries not yet collecting stages can provide it based on main travel mode in which case all distance of a given trip is allocated to the main mode used for that trip.

By train (total)				
High-speed train				
Regular train				
Urban rail				
Aviation				
Waterways				
Cycling, Walking, Other				
c) By fuel type (passenger car)				
Petrol				
Diesel				
Petrol electric				
Diesel electric				
Electric vehicle (E.V)				
LPG				
CNG				
Hydrogen				
Other/unknown				
d) By travel purpose				
Professional				
Personal				
4. Travel time per person Total number of overnight stays				
a) Total				
5. Passenger kilometres (pkm) for all reference population / year				
a) Total				
b) By travel mode[17]				
By passenger car (total)				
By van//camper				
By motorcycle and moped				
By bus and coach				
By train (total)				
High-speed train				

[17] Based on all stages of a trip; countries not yet collecting stages can provide it based on main travel mode in which case all distance of a given trip is allocated to the main mode used for that trip.

Regular train				
Urban rail				
Aviation				
Waterways				
Cycling, Walking, Other				
c) By fuel type (passenger car)				
Petrol				
Diesel				
Petrol electric				
Diesel electric				
Electric vehicle (E.V)				
LPG				
CNG				
Hydrogen				
Other/unknown				
d) By travel purpose				
Professional				
Personal				
6. Average vehicle occupancy				
For passenger car and taxi				

4. Recommendations on methodology

4.1 Introduction

This chapter focuses on recommendations linked to methodological aspects of designing surveys that are directly relevant for (a) a regular execution of National Travel Surveys (NTS), (b) the quality and validity of data collected through NTSs, and (c) the potential to obtain information needed for compiling indicators presented in Chapter 3 of the current document.

The ideal situation would be to have information on mobility of all persons within a country, irrespective of their nationality and permanent residence. However, methods and sampling frames used for a NTS (presented below) can only include country inhabitants (nationals and non-nationals with a local residence) and not for instance tourists or cross-border commuters from neighbouring countries. The size and effect of foreign visits has to be found by for instance cross-border counting, statistics of tourists' overnight stays, surveys made in airports, and dedicated web or telephone surveys for which contact is obtained through a postcard survey at the borders.

When considering the practical implementation of a NTS, one should be aware that a travel survey is very different from many other surveys conducted by NSIs in the way that the object of the survey, travel behaviour, is influencing the implementation of the survey according to both response rate and item non response. The core information of a travel survey is the number of trips. If a trip is missing in a response, kilometres, travel time and all other indicators are too low. It is therefore crucial to get information of all trips. As mobility depends on the socioeconomic characteristics of the respondents it is especially important to obtain answers from a representative sample and avoid biasing the response rate.

Busy people are more difficult to contact, simply because they travel more. Hence, missing busy people bias the results more than missing a few 'typical' travellers. At which time of the day and week potential respondents are contacted for a CATI or CAPI is influencing the share of busy people available for an interview. On the other hand, experience shows that busy people are often more interested in transport than others and therefore easier to obtain an interview when contact is made. The final response rate for busy people and thereby the potential bias might be limited if a specific effort is made to include them. Old people are easier to contact but they are also travelling less than younger people. Families with children travel less than couples and far less than singles. However, the number of members of a household is influencing the response rate, too. Those who are missing depend on the survey mode. The relations between response rate and age, social situation, family size etc. is of course known to the NSI but how it biases the outcome of the survey is less known, whereas this is important when choosing the methodology. Some of the aspects will be outlined in the following.

Furthermore, it is not only the more simple effect on response rate which is relevant to be aware of. Some sophisticated techniques of respondents to avoid the burden of an interview are important as they can bias the results. A special group to be aware of is the so-called soft refusers who are not denying participating but instead pretending as if they participate but are not honest about their real travel activity. People who have had many trips at the travelling day risk stopping answering when they get tired. They might either interrupt the survey or they might leave out trips. Another type of problem is the memory recall effect where people forget some trips or how they really travelled the actual day. Some forget which day they made a certain trip.

Research has shown that such biasing behaviour depends of various aspects of the chosen methodology, e.g. survey mode, interviewers (if interviewers are involved), different aspects of the attempt to contact the respondents, the structure and quality of the questionnaire.

All such relations between the survey methodology and the outcome of the survey are therefore important to be aware of when choosing a survey methodology and conducting a travel survey. There is however no specific methodology that represents the best solution for all cases. A chosen approach might be good in some way but will need compromises in other aspects. Only a few recommendations are universal: Experience, thorough and patient preparation and constant follow-up are paramount to obtain high-quality results.

The current chapter presents some recommendations on different aspects of the methodologies and describe

the pros and cons of each choice. The text does not pretend leading to optimum final results as new experiences can always be added when practice shows new aspects. Comparison of results between different countries and over time are always good ways to gain awareness of aspects of the effects of methodology. Differences between countries and changes over time are both a result of changed behaviour of the population and of differences and changes in methodology.

The chapter outlines possible solutions from which a suitable methodology needs to be developed for each specific country. For countries that currently have no existing NTS practice, the methodological recommendations may serve as a guideline, which should be implemented taking into account national and practical considerations.

Countries need to check, inter alia, their own national legislation (e.g. related to legislation on privacy and confidentiality, data collection principles, etc.) in order to ascertain compliance. In some cases, this may mean that the NSI (or another body responsible for the NTS and for data collection) need to obtain specific dispensations or a working rule from relevant national administrations. Countries where NTS practices already exist are asked to verify whether the quality and content of data collected would be similar to data collected following the suggested methodologies. In case of discrepancy, the country may consider some alignments with recommended methodologies when periodical revisions of the existing national surveys occur.

4.2 Reference population

One of the first elements to be considered is the identification of the reference population to which the NTS is to be analysed.

The most relevant parameters that need to be taken into account when defining the reference population are the included age groups and the criterion of “nationality” versus “residents”. The ideal situation would be to have information on mobility of all persons within a country, irrespective of their nationality and permanent residence. However, sampling frames used (further discussed below) only tend to include country inhabitants (nationals and non-nationals with a local residence) and not for instance tourists, cross-border commuters from neighbouring countries, exchange students, etc. There is no immediate solution for this, apart from correcting received information afterwards, based on additional data sources and dedicated studies. The number of the foreign visits can be obtained by cross-border counting together with the survey (registering the resident’s outward crossings), statistics of tourists’ overnight stays indicate the length of the stays. Further information about the guests’ activity can be collected by a dedicated web or telephone survey for which contacts are obtained through a postcard survey at the borders. A survey where data are collected in airports is an additional option.

Therefore, the definition of the reference population recommended in Chapter 2 is that the country population is understood as all residents in the country regardless of their nationality. In practice, some groups are difficult to approach, e.g. people living in multifamily households for elderly, handicapped etc. and people only mastering foreign languages which the interviewers are not familiar with. In principle, these groups should be included even though some countries are excluding them from the sample.

As far as age is concerned, the existing national practices vary considerably, ranging from countries that include all age groups to those with various lower age limits (varying between 6 and 16) and finally a couple of countries with an upper limit of age 84. These differing national practices are usually justified by national policy needs and they are rarely changed because they have an impact on the overall survey costs. In order to achieve comparability of indicators reported across countries, it is recommended that all countries compile those indicators on the basis of age group 15-84 inclusive only. This corresponds to a great extent to what is at present the smallest common denominator among national practices. However, countries having an even more restrictive approach (a lower age limit at e.g. 16 or 18) are kindly requested to envisage aligning with the recommended minimum age brackets.

4.3 Sampling

Obviously, it is impossible for a NTS to collect information from all members of the reference population. It suffices to collect information from a sample of the reference population, insofar that this sample is representative for that reference population. The quality of a sample depends on two elements: the sampling frame and the sampling method. In the following paragraphs, different options are presented for both sampling frame and sampling method.

Sampling frame

The sampling frame is the source population from which a subset is drawn to participate in the NTS. Different sources can be used:

- databases registering the entire reference population individually: a civil population register, a national voting register, a tax register, census
- databases registering households: postal information datasets (addresses), census,
- databases registering a subset of the population based on other information: telephone registers, interviewer panels generated by a marketing company

It needs to be taken into account that some sources implicitly exclude population subsets. Most precise are usually the civil population registers: they are normally most up to date and should include all residents. Voting registers and tax registers are in some countries missing the younger (those under the age of 18). In case the country has no full population register the census might be the best alternative, even though a part of the population might have moved since the census was held, especially among the younger. Postal address databases can exclude new dwellings or migratory persons, etc.; however, some errors can be reduced if a new dwellings register exists. Telephone registers are more limited because they only include telephone owners. In some countries only land-line telephone registers exist but it may exclude households with mobile phone only (and no land line) . Even with a cell phone register, people having a secret number or having a pay-card phone number are left out. Random-digit-dialling in which a computer generates random numbers and call them is however a possibility to approach all people having a phone. The method is used by a marketing company for the German MOP and other surveys. Proceeding this way, a large database is established once a year. But again, the method is biased as it may exclude some parts of the population (for instance those households having mobile phones only). All business telephones need to be left out when approached to avoid over-sampling of employed people.

Most biased are of course access panels because they are built on people who have accepted to participate in many consumer surveys and therefore normally exclude e.g. busy, highly educated and wealthy people. In case they are surveyed by web only they are even more biased, because only motivated people by transport are willing to answer through the internet (Christensen, 2012).

Another choice is between the sampling of households and the sampling of individuals. When access to a civil population register with individuals exists, it is possible to sample individuals. When the register is organised by households, or only address sampling is possible, sampling of households is then most common. Censuses are probably organised per households and household sampling is the most obvious solution. However, considering that all members of the household report to a census, it might be possible to sample individuals. The question on sampling individuals or households is further addressed in Section 4.4.

Sampling methods

The sampling method is the procedure that is followed to select individual participant units (individuals or households) from the sampling frame. In general, a distinction is made between probability and non-probability sampling. When using probability sampling methods (for example random sampling, cluster sampling and stratified sampling) all members of the target population have a known probability of being randomly selected that is different from zero. When using non-probability sampling methods (for example quota sampling, judgment sampling and convenience sampling), a non-random method for selecting members from a target population is used. Because of the non-random element, the latter group of methods cannot be recommended for a NTS.

Examples of probability sampling are:

- Simple random sampling: Each individual of the population has the same, non-zero, chance of being selected. It can be done by computer, generating a series of random numbers and adding these to the used register. When the register is sorted according to the random numbers, the needed number of persons or households can be drawn from the bottom. When the sample is drawn from the bottom, the sorted data can only be used once. For the next sample a new sorting is needed. An alternative method is therefore to pick every X^{th} member from the register starting from a random start person. X is similar to the number of persons in the reference population divided by the sample size. This method can be used for several samplings (for different surveys or for the same survey with a month in between). It is needed to start the picking up of persons for the sample by different start persons and with different X's for each sample. The sample frame is assumed to be without a hidden order. The problem with this method is that the registers from which the sample is drawn is normally ordered e.g. by birthday, alphabetically, by geographical area (municipality) etc. which can result in picking the same persons/households more often if the starting point is not changed from one sampling to the next.
- Stratified random sampling: To make sure that the distribution of the sample is correctly representing the main population groups geographically, by gender and by age, it is possible to divide the population into a number of strata first. A stratum is a common characteristic shared by a subset of the population. For example: urban size, gender or age group. In a second step, a random sampling is used to select a number of persons/households from each stratum. The size of each sample has to be equivalent to the relative proportion of their representation in the entire population. In practice, a slight bias may occur as a result of the use of a specific sampling frame. This bias needs to be identified, but not necessarily corrected.

Examples of non-probability sampling are:

- Quota or Cluster sampling: this is the non-probability equivalent of stratified sampling in which each stratum is not equivalent to the relative proportion of their representation in the entire population. Quota sampling cannot generally be recommended for a NTS; however, it is acceptable if a group for some reason needs to be oversampled. It can be an age group that has a very low response rate (e.g. the age group 18-25 year); the oversampling of the group is needed to obtain enough respondents in the group to calculate their travel indicators. It can also be used for oversampling a region or municipality if the community pays for getting indicators for their area separately. In such cases more observations are needed to report some indicators with a lower margin of error than what is obtained by a random sampling in the entire population. In case of such an oversampling it is important to calculate a weight for the oversampled group separately, e.g. for the 18-25 years age group, or for the oversampled region when the observations are pooled with the rest of the country. Quota sampling is always the case when running a continuous survey and the results from each year are pooled. Each year will have its own set of weights. Quota sampling is also sometimes used for surveys with the purpose of collecting data for transport modelling. For this purpose clusters are selected for certain geographical areas, age groups, groups with and without car, etc. Each cluster has to be large enough to obtain a certain margin of error. If the chance to be sampled is very different for the members of each of the quota, the variance across the overall sample is problematic for the analyses across the aggregated dataset, especially when the weights for a few of the quotas are very high.
- Convenience sampling: the sample is purely selected based on convenience. This may be an appropriate method only during the exploratory stage of a study (for example to test the functioning of an NTS).
- Judgement sampling: the sample is selected based on the judgement of the researcher. This may be an appropriate method only during the exploratory stage of a study (for example to test the functioning of a NTS).

Sample size

Often related to sample methods are issues concerning sample size. These issues depend on the planned analyses, e.g. the indicators needed and the sub-groups to be analysed. Only a low number of respondents

is needed if the modal choice distribution of the entire population has to be stated, whereas a very high number is needed if the modal choice at each origin-destination relation between 2 000 traffic zones (with 4 million relations) is needed.

In essence, it is impossible to set a specific percentage (of persons included in the sample, compared to the population size) that is representative for every population. Furthermore, response rates can be very different for different countries. This makes the net sample size (the number of usable/valid returns at a unit level) important.

The method to assess the size of the sample depends on whether the analysis concerns proportional distributions of persons or trips on e.g. modal choice, purpose and similar or if it concerns the distribution of continuous variables such as travel distance or travel time on modes. The method to assess the latter is following below. For the proportional analyses, reference is often made to Cochran's formula (Cochran, 1963:75) cited from (Israel, 2013):

$$n_0 = \frac{Z^2 * p * (1 - p)}{e^2}$$

Where n_0 is the sample size, Z^2 is the abscissa of the normal curve that cuts off an area α at the tails and (1- α) equals the desired confidence level, e.g. 95%, *x* is the desired level of precision, *p* is the estimated proportion of an attribute that is present in the population. The value of Z is found in statistical tables containing the area under the normal curve. For a 95% confidence interval it is 1.96. The formula is only correct in case of random or stratified random sampling. In case of quota sampling the size of each sub-group needs to be considered.

Choosing a correct net sample depends on the following elements:

- Desired precision of results (margin of error, *e*), i.e. the difference between the real and the sampled population. A lower desired level of precision requires a larger sample.
- Confidence level (α): the chance that the sample taken contains the populations' true values within the precision of results defined. A higher confidence level (1- α) requires a larger sample size. Z^2 can be found in statistical tables for the normal distribution. *Z* is 1.96 for a 95% confidence interval.
- Degree of variability (*p*): the distribution of attributes or concepts that are measured in the questions in the total population. "*p"* is proportion of the population with a certain characteristic. A homogenous population is easier to measure than a heterogeneous population. The degree of variability is often estimated based on prior information or expert information.
- Response rate: n_0 is the demand for valid responses (net sample). To find the needed gross sample the number of respondents should be divided by the response rate. From the SHANTI project it is known that response rates of the existing NTSs between 20% and 70% can be achieved. In practice, this means that 14 000 to 48 000 individual persons or households need to be contacted if 9 600 observations are needed.

Some examples:

- A margin of error of 5% means that the true value of a population is within +/-5% of the value that is found in the sample. If the value of a survey indicates that 20% of the people in the survey sample use public transport, and the margin of error is 5%, this means that the real population value probably lies between 15 and 25%.
- A confidence level of 98%, given a 5% margin of error means the following: if 100 simple random samples were taken, we expect 98 of these would differ from the real population value by at most 5%. With the above example it means that for 98% of identically sized samples the results will be between 15 and 25%
- A population with a 50%-50% division on an attribute is considered very heterogeneous. A population with an 80%-20% division is homogenous.

In the case of NTSs, it is suggested to aim at a margin of error that is not bigger than 5% and a confidence

level of 95% or better for the required indicators. For example, if a margin of error of 1% and a confidence level of 99% is targeted, the result of Cochran's formula shows a need for 16 500 completed responses (with *p*=0,5). In case of a margin of error of 1% and a confidence level of 95% is targeted, most EU countries should aim for around 9 600 completed responses. If the required precision is 5% the need is only 384 observations.

The examples based on a net sample however only show the need for respondents for observations at the overall level. A breakdown of data to working days / non-working days and to urban / non-urban reduces the number of observations in each cell and more observations are needed to obtain the demanded margin of error. On the other hand the indicators are measured for trips and not on respondents and each respondent makes around 3 trips per day which again reduces the need for respondents.

Table 4: Number of respondents needed with different levels of precision *e* with a 95% significance level and a 05/0.5 distribution (*p*) shown for respondents for the entire population and for trips in an urban area on working days and non-working days.

			Entire population	For trips in different sub-groups			
Demand to the sample			Needed sample size	Share of trips in Urban areas	Share of trips in the week period	Number of daily trips in average	Needed sample size
e	Z^2	*p*	n_0				n_0
Weekdays							
1%	1.96	0.5	9604	0.5	0.75	3	8537
3%	1.96	0.5	1067	0.5	0.75	3	949
5%	1.96	0.5	384	0.5	0.75	3	341
Weekends							
1%	1.96	0.5	9604	0.5	0.25	3	25611
3%	1.96	0.5	1067	0.5	0.25	3	2846
5%	1.96	0.5	384	0.5	0.25	3	1024

Table 4 shows as an example that in case 50% of the trips are urban and 75% are made on working days, the sample size needed at different levels of precision is more or less the same as needed for the overall level for respondents. The need for included respondents is higher for weekends than for working days, resulting in a lower level of precision in weekends with a given number of respondents. When considering the number of respondents, it is also necessary to consider the possible wish to break down the results by age and gender, automobile classes, etc., resulting in levels of precision which may easily exceed 5%. If the purpose of the survey is a good precision at regional level, a much higher number of respondents is needed. For several years, the Dutch survey has had more than 100 000 annual respondents to obtain a high enough precision at regional level (Evert et al., 2006).

However, the need for observations is only calculated for a distribution of trips. Indicators for the mean mileage and travel time are also required, for which another formula of the needed number of trips is required:

$$n_0 = \frac{Z^2 * \sigma^2}{e^2}$$

for which σ^2 is the variance. To calculate the desired number of observations, knowledge of the distribution of travel distance has to be known or at least knowledge from other surveys has to be obtained. By collecting data from other countries, it is important to be aware that travel distance distributions are more country-specific than the distribution of e.g. the number of trips. It should especially be considered that the distribution on short- and long-distance trips is crucial for the final precision, as trips over 100 km are few and their mileage is influencing the overall mileage substantially. The final level of precision on mileage should therefore be verified.

4.4 Survey methodology

Within the current section, more detailed information on the methodologies for collecting travel behaviour information from respondents is presented.

Data collection methodology

Four main survey modes can be identified to collect the interviews, Paper-and-Pencil, Telephone, Face-to-Face and Web-based and similar electronic self-administered methods. Paper-and-Pencil interviews always need to be coded, as to enter the results into some kind of databases. Conversely, the web interview is always computer based and the resulting data will end up automatically, without any further workload for the survey team, in a database. The same is normally the case with telephone interviews in which the interviewer is guided through a computer-based interview and enters the answers directly into the questionnaire (e.g. on a laptop). A face-to-face interview today is normally guided by a questionnaire stored on an electronic device. The three computer-assisted modes are therefore often shortened CATI for telephone interviews, CAPI for personal interviews and CAWI for web interviews. PAPI, for Paper-and-Pencil interviews, is covering both self-administered surveys received e.g. by mail and personal interviews without computer-backup, postcards delivered at stations, in airports etc.

During the last ten years, modern communication technologies have been tested for gathering information in other ways too, e.g. by GNSS-tracking and smart-phones. GNSS tracking needs to be combined with a traditional survey to get background information. A smartphone can combine a web-interview by the phone with tracking during a period. Identification of purposes and modes by questions underway is possible when information seems to miss. These methods may replace or supplement the traditional survey-based methods in the future. For the moment the two most important problems consist of the fact that the respondents are not randomly picked because of under representation of some sub-population (for instance, those not having a smartphone); and the fact that a trip is not easily identified in the same way as it is defined in Chapter 2.

Another new option is network tracking of mobile phones, which offers information by automated data-gathering. In this way, the routes of people can be registered. Others have tried to obtain more information about each user's behaviour but the results are not yet comparable with results from surveys, possibly due to an extreme response bias and because short trips are underreported when the zones are big, for instance in rural areas. Information about the purpose of the trip and the background of the traveller is missing too. Neither mobile phone data nor tracking seems to be an option for NTSs right now but development is very dynamic and should be observed carefully.

When looking at the currently used survey methods some pros and cons can be mentioned.

1. Telephone interviews (CATI) are today the most widely spread survey methodology. Normally the sampled respondents are contacted by mail in which the survey is introduced and the travel day is assigned.
   a) The strengths of this methodology are:
      - It is cheap compared to CAPI.
      - Interviewers can guide the respondents through difficult questions related to e.g. definition of trips and purpose and they can quickly fill in address information, as they are trained to do this.
      - Telephone interviews are the best way to approach the age group over 60-65 because they are underrepresented in web interviews and not always willing to let in foreigners for a personal interview.
   b) The weaknesses are:
      - Missing information about telephone numbers. When the respondents are sampled in e.g. a civil population register or an addresses register, the telephone numbers need to be found. Then the same problems occur as with sampling among telephone registers: mobile phone numbers registers are not available in some countries (e.g. in Germany) or the registers are not updated, numbers are unregistered (telephone-cards) or secret. Furthermore, less and less people have a land-line phone. The none-response rate is therefore increasing due to missing contacts.
      - An interview cannot be too long. The best is around 10 minutes on average. Interviews by phone longer than 15 minutes are reducing the response rate in a biased way.
      - Interviewers are always influencing the respondents by their language, politeness etc. This can work both ways: on the positive side for instance by convincing people to respond when they do not want or get respondents through a survey when they intend to stop; and on the negative side by for instance hurrying the respondent up or by speaking a non-fluid native language which

irritates the respondent resulting in higher non-response rates, more respondents with less trips and even more without trips. It is known that interviewers are also influencing the answers to attitude-related questions (respondents want to be polite in order not to give 'unacceptable' answers even when this is their real attitude).

- Furthermore, a telephone interview needs to be finished after an acceptable duration; either the interviewer or the respondent is pushing to get the dialogue to an end. This may result in less time to pick up forgotten trips or to correct a wrong answer. Evidence for this has been found from a comparison of the results from CAWI and CATI interviews of which the latter had little less trips from a few kilometres to around 40 kilometres (Christensen, 2012).
- More generally, a telephone interview cannot be too long. The best duration is around 10 minutes on average. Interviews longer than 15 minutes reduce the response rate in a biased way.

2. Personal interviews (CAPI) are also started by a mailed out letter. An agreement by phone can also be made in case a telephone number is found or the interviewer might just turn up.

   a) The strengths of a CAPI are:

   - Contact can be obtained with people without a (known) telephone number. Responses can be obtained from some low-income groups with whom a telephone interview is difficult or contact is not obtained (an experience from the Netherlands).
   - Interviewers can guide the respondents as with the CATI and even more because the face-to-face contact might show when the respondent is in doubt. Indeed, with a face-to-face interview, interviewers can take their time to explain all concepts and definitions to the interviewees.
   - The interview can be longer than a CATI and include more questions, e.g. both a daily and a long-distance travel interview. 30 minutes is acceptable.
   - Interviews with entire the household can easier be obtained when the interviewer is in the home.
   - None-native language speaking people can be easier to interview with the help from other household members.

   b) The weaknesses are:

   - The cost of travelling to obtain contact to the respondents is high. Some of the costs can be saved if more respondents can be interviewed per visit in case of household surveys. A longer interview with both daily and long-distance travel might save time because those using a CATI might conduct two surveys and therefore use more time on sampling, mailing, calling and collecting background information from both surveys. When the diary is left to self-administration afterwards, more time is saved.
   - The interviewer effect might result in a lower response rate because of the appearance and not only the voice of the interviewer. It is more difficult to replace the interviewer if nobody in the household speaks the native language or another commonly known language, (e.g. English). By telephone, interviewers that speak many languages have more chance to enrol interviewees that do not speak the country language.

3. Web interviews (CAWI) generally requires another type of communication for the invitation, due to the lack of sufficiently representative E-mail registers and the self-selection bias.

   a) The strengths of the web interview are:

   - Cost, as nobody needs to be involved in the answering process.
   - There is no interviewer effect.
   - The respondent can use more time for recalling all trips or look up missing information which is not available during a telephone interview.
   - It is easier to obtain more correct answers to attitude questions. But these are not very usual in a NTS.
   - Answers can be obtained from respondents without a known telephone number.

- With a good programme with many consistency checks in the answers, a higher quality in the answers can be obtained compared to the three other survey modes.
- Busy people might be easier to approach because they can choose the right time to answer. However, experience from Denmark does not prove that people travelling long distances daily (identified by long commuting distance) are responding more often than by telephone.

b) The weaknesses are often the opposite of the strengths of a CATI:

- There is no help to explain the definition of a trip and interfere in case of mistakes or to help with registering addresses. This results in less short trips (less than 1-2 km) and more need for after-care with 'gluing' stages together into trips or looking up addresses. Some of the savings from a face-to-face interview costs are lost again
- The response rate is low and biased. A follow up to respondents who have not answered or not finished the questionnaire is needed. Especially people over 65-70 years have a low response rate whereas children are very active on the web. Unfortunately the response rate is very low for people without known telephone number. A reminder might be an option but in case the response rate is very low again, the cost per obtained interview becomes high.

4. A mailed out paper-and pencil survey (PAPI).

a) As with the CAWI there is no interviewer effect and no help from the interviewer in case of problems. The strengths are:

- It is cheaper for small surveys than the interviewer-administered surveys because of the saved interviewer costs and savings as no computer programme for the survey needs to be developed.
- The responses might be less biased because it is not influenced by the sampling frame from telephone registers.

b) However, most effects are on the negative side:

- Less information can be collected than for any of the other survey modes.
- Some of the savings are lost when the questionnaires have to be coded afterwards.
- There is no possibility to control the answers for inconsistency during the interview or to push the respondent to answer to a question. The result is therefore a lower quality, but it may be improved by a validation call;
- It is more difficult for the respondents to obtain a clear overview if many questions are conditional and the respondent has to move up or down in the questionnaire. It is also difficult to include as many explanations as could be done in a survey with interviewers.
- Normally the response rate is lower than what can be obtained from the interviewer-administered surveys. The sample therefore needs to be 50-100% higher than the size of a CATI; mailing costs will be higher. However, it depends on how many telephone numbers can be found for a CATI. A follow-up mail is needed, too, and low response rates might also result in more biased data.

Several countries are mixing these methods today. In Denmark and the Netherlands the respondents are contacted by a letter and asked to answer by a web-based survey to which they are offered a log-in code (Christensen et al., 2013). Those who are not completing the interview through the web (or only partially) are contacted by telephone for a CATI. In the Netherlands, a third attempt is made for a personal interview concerning those who have still not answered, perhaps because the telephone number is unknown. Both Norway and Sweden are following the same procedure for their new NTSs. In 2008, the German MiD collected the background information by web while the diary was answered by telephone. In the UK a CAPI is combined with a PAPI. The interviewer visits the household at home, completing the background information and leaving the diaries to be completed during the following week and returns to pick them up later. The 2013 Austrian NTS has offered the option to the respondent to choose between CATI, CAWI and PAPI. 85% chose to complete and return the questionnaire.

Only a few countries use PAPI, but both the German MOP and the new MiD are conducted fully as PAPI because of the very low level of known telephone numbers which reduces the response rate substantially.

Until 2010 the Dutch survey followed the KONTIV design (see e.g. http://www.socialdata.de/info/KONTIV_engl.pdf) which is another mixed survey mode. The respondents complete a very simple PAPI questionnaire with only very few predefined variable categories. The respondents were contacted by telephone when they had received the questionnaire to motivate respondents and supply additional explanations. After the questionnaire was returned, participants were contacted again to validate the answers and obtain more details about e.g. trips by public transport. Special additions to the survey were in general made by telephone, e.g. diaries from young children (Evert et al., 2006). With such follow-ups by telephone and a simple questionnaire the survey had a higher response rate and much better quality than a simple PAPI.

Individual or household survey

In many countries the national travel survey is called a household survey indicating that travel information is collected for the entire household. Only the four Nordic countries (Norway, Sweden, Finland and Denmark) and the Netherlands (since 2010) are sampling individuals based on national person registers while the rest of the countries performing a NTS are sampling households or families. Even though households are sampled, several countries only collect diaries from one or two persons in the household. Switzerland for instance chooses two respondents from large households and one from smaller households while France only chooses one respondent from a household, independent of the size. Only the British NTS is a genuine household survey for which all household members have to participate. The German MiD accepts interviews for which at least half of the members of the household have reported trips.

The strength of a household interviews the possibility to analyse the travel behaviour of families and unveil the influence of each family member on the behaviour of the rest. But only the behaviour of full households is of relevance for this purpose. The downside of a household or family interview is the fact that there is less geographical variation and dependency in behaviour due to the interaction between the members. The more family members, the higher the risk that one or more family members to deny to participate or not to be available for an interview during the contact period. The response rate is therefore lower for big households. The risk for proxy interviews (where others are answering for the missing person) and thereby a lower quality due to missing knowledge about the real behaviour, is higher, too.

For most analyses of travel behaviour, each individual respondent from the household is treated as an individual, irrespectively how the individuals are sampled. This is also the case for the indicators to be provided. For this purpose, an individual sample is the most random and therefore results in the highest statistical precision for a given sample size. This can be obtained by sampling either from a person register or based on knowledge of the inhabitants from a census. In case households are chosen as sampling frame it is best to include information about the household size and oversample the large households accordingly.

For the analyses of individuals the response rate is lower for members of large households when only full or nearly full households are accepted. For one-person households, the response bias turns the opposite way because the chance to get hold of the sampled persons might increase when other members of the household can communicate contact to a missing person.

In case the distribution of the population on household size is known, it is possible to compensate for biases due to different response rates in large or small households by weighting the answers based on household size. Households can be defined in different ways, e.g. as persons in the same dwelling, everybody with any familiar relation or only a couple/single with their (common) children. The definition in both survey and register has to be the same when weighting. In case the distribution of the population on household size is unknown, it is impossible to compensate for this bias by weighting the answers. This is for instance the case when a postal address register is used as sample frame.

The choice of sampling frame is the countries' own decision and should be based on the national purposes of the use of data. However, for countries starting a new NTS, the recommendation is to choose an individual sample frame if possible. This will result in the most representative sample and the fewest problems with getting in touch with the sampled respondents.

Repeated participation and panel surveys

The respondent participation in a survey can be a one-off (single participation) or repeated. The latter is normally referred to as panel participation. This should however not be mixed up with the consumer panels

performed by marketing companies. When comparing a single vs. a repeated participation, the main advantages of a panel survey are that:

- It allows for good tracking of mobility pattern evolution over time. The non-response rates are however expected to be higher due to a higher response burden, and more biased than in case of a single-time cross-sectional survey;
- It allows for respondents to get familiar with the data collection method but with a year in between this effect is very limited;
- Cost per interview in case of a CATI is somewhat lower because some background information can be reused and only needs to be checked.

A panel survey is not relevant in case of a one-day survey because the change of mobility from one day to another is so high that it is impossible to separate the random change in behaviour from the real change at the level of the individual. Change in behaviour at the statistical level can easily be analysed by a continuous survey as well as with a panel survey. A multi-day survey is therefore needed as is the case with the German MOP for a panel survey to actually benefit from the advantages of a panel over a cross-sectional approach. And this has other downsides (see further below). The reason why the methodology of the German MOP is chosen is most likely motivated by an interest in analysing how changes in car-ownership preferences influence mobility: for instance changing from not having a car to becoming owner of one or more cars and the other way around. For this purpose the one-week survey is useful. In Germany the two surveys, the MOP and the MiD, are supplementing each other. Analyses of indicators measured per trip-maker at the country level are furthermore surprisingly similar in MiD 2008 and MOP.

A final reason not to recommend the choice of a panel survey is the representativeness of the survey after a cycle. In case 10,000 respondents are interviewed per year the mobility of 30,000 respondents is known after 3 years with a normal continuous survey. In case of a panel the mobility is still only known for 10,000 respondents. This means that the coverage of different kinds of urban and non-urban areas is much smaller.

Should a multi-year panel be selected as a survey format, a choice has to be made on the panel renewal rate. As with the MOP, a 33% annual renewal rate can be used. After the fourth year of the NTS, 33% of the respondents are third time respondents, 33% are second time respondents and 33% are new first time respondents. If there is a drop-out of respondents over time, these should be replaced by first time respondents. In practice, this means that the equal proportionality of 33% over time cycles cannot be upheld.

4.5 Data collection protocol for a cross-sectional survey

A cross-sectional survey means that the respondents are asked what they have been doing on one certain day or during all days over a short period. The answers are reported in a diary which is expected to be completed immediately or short after the respondents have been travelling so that there are no memory problems related to these activities. In reality, it is however not always possible to complete the interview immediately after the travelling day/days. This section will discuss methodological questions related to completing a cross-sectional survey. A National Travel Survey always includes a cross-sectional survey with a diary. Sometimes it also includes a retrospective survey. The data collection protocol for a retrospective survey is discussed in the next sub-section (4.6).

Frequency of a survey

As the purpose of collecting indicators is to identify development in travel behaviour over a long time span, it is important to use data collection methodologies which can accommodate this development. One of the most important questions is the frequency of the surveys. Changes in contextual factors for travel behaviour can be frequent and influence the behaviour substantially, such as fuel prices and fares. But changed rules and restrictions on access to certain city areas (e.g. environmental zones) can also influence behaviour over short periods. Other changes such as infrastructure investments develop over longer time spans. To be able to identify and monitor the effect of changes, the interval between the surveys is important. Methods to identify the effect of dynamic changes in travel behaviour is discussed in (Gerike and Lee-Gosselin, 2015).

Three types of periodicity among the current European NTSs can be observed: (1) continuous surveys (day-after-day without interruption), (2) surveys running for a year every 4th - 8th year and (3) a one-off survey with large time intervals.

Four countries are currently running a continuous survey. The Netherlands (since the 1970s) and the UK (since 1988) have conducted a continuous survey and Denmark since 1992 with a short interruption in 2004-05. In Germany, the MOP has been running continuously since 1994. During certain periods, Sweden had a continuous survey.

A group of countries are conducting one-year surveys with a predefined frequency, e.g. Norway every 4th year and Finland and Switzerland every 5th year. The German MiD and the Belgian surveys are also full-year surveys but they are running with a somewhat longer time span in between each wave. The French, Spanish, and Austrian surveys are full-year surveys too; however, they are conducted more irregularly.

Finally, Cyprus, Latvia and Ireland conduct periodical surveys for shorter periods than a year.

The strength of a continuous survey is:

- It is possible to follow the development over time.
- It is possible to identify and separate the effect of the most dynamic changes as fuel price changes and extreme weather conditions from the more long-term changes.
- Several years can be combined for analyses of detailed person groups or questions for which a high amount of observations are needed, especially for the development of a national transport model.
- The organisation which runs the survey (development of questionnaire and survey protocol, engaging the data collection company, following the development in quality, reporting results etc.) can be the same over a very long period, resulting in stable survey methods and quality.
- Institutionalisation of the financing of the survey is a precondition, e.g. as a part of the national budget and may secure an environment for long-term quality development.

The weakness of a continuous survey is:

- Along with the routine of an established data collection, the concentration on keeping high quality tends to decrease. This is the case at both the organisational level and the individual level by the interviewers.
- Reporting and systematic analyses of the collected data is not a need and the results from the collected data are not always published systematically except for a few indicators. Not to say that in-depth analyses and publication of results are made for all NTSs, Norway is an exceptional example.
- Changes in daily and urban mileage are only 1-2% per year and in some countries even less. The number of observations per year therefore needs to be high to be able to distinguish effective development from data uncertainty over a short period.

For a further discussion of a continuous survey, please refer to (Ortúzar et al., 2011).

Some countries prefer to run the survey with certain intervals. For these countries each survey is on the one hand a special survey which has to be analysed and reported in detail after the data collection process. On the other hand, when the breaks between the surveys are not too long, the development in behaviour can still be analysed. Furthermore, the survey process can be scheduled in 4 periods which makes it possible to see the organisation of the survey as a continuous process:

1. preparation with inviting sponsors or regions which want oversampling or special analyses, call for tender for the data collection, development of the questionnaire, survey protocol, etc.;
2. conducting the survey;
3. post-processing and quality control;
4. analyses and reporting.

In case an institutionalised routine is established as described above it might be possible, as with the continuous survey, to get the survey secured in the national budget in the same way as is the case with a continuous survey. The strength of this procedure is that it is easier to avoid the risk of a decreasing quality

due to routinely collected data as with a continuous survey.

A problem to be especially aware of is the risk of introducing biases caused by changes in the methodology, data collection protocols or questionnaires as a result of e.g. change of the responsible organisation. This may happen if the responsible organisation is chosen by a call for tenders. The experience accumulated is then not transferred from one organisation to the next. When conducting a continuous survey such changes can be observed immediately after the change and care can be taken for compensation (or at least explain it). For surveys with some years of interval it is impossible to know if changes in behaviour are due to the changes in the survey or modified travel behaviour.

Finally, it needs to be recognized that making use of data for purposes of policy support becomes more difficult with long time periods between the surveys since multiple policy implementations and the general development in travel may affect mobility behaviour over longer periods. Here, 5-year periods are probably the longest acceptable interval.

As a general rule of thumb, it is suggested that continuous surveys are preferred over annual surveys because of a lower likelihood for introducing time period biases. Both are however preferred over longer survey repetition frequencies (more than 5 years).

Coverage of days of the week and periods of the year

Information collected through travel surveys should be representative for the entire year and all days of the week. Most European NTSs therefore collect data for all 365 days of the year, and this is indeed the recommended approach.

A few Member States, however, only conduct a survey during a shorter time period (e.g. one month). Reasons for this can be a limited sample size which is more cost-effectively collected over a shorter period instead of a few interviews each day during the entire year. In case of a survey with a sample size of over 10 000 persons, at least 30 persons are approached each day and normally at least 10 respondents are interviewed. In this case an all-year-round survey is always recommended. This is especially the case if information on multi-day travel is collected because it takes place more frequently during the holiday periods in summer and around Christmas, but also in spring for instance, with some extra non-business days in many countries.

In case a shorter survey period is chosen, a well-grounded selection of the survey period is required based on which an extrapolation or comparison with all-year surveys can be made. First of all holiday periods need to be avoided, even short holidays are influencing travel behaviour. A shorter data collection period than a year implies a need for post-processing of data with an appropriate weighting based on other data sources. In practice, data from databases are populated independently from the travel surveys e.g. automated counts of vehicle traffic, bus ticketing services, and on-board survey. The general experience is that a survey period during autumn is the most typical period and therefore the best choice, but periods with an autumn holiday should be avoided. Autumn is preferred over spring because of several short holidays which changes in travel behaviour. The spring is also a period with warm days and, at least in the northern part of Europe, a period with more sun after winter and therefore an increasing number of outdoor activities compared to the rest of the year.

Data collection for both working days and non-working days is therefore strongly recommended. Most NTSs are today running each day during the week, resulting in a representation of the weekend by around 2/7 of the interviews. A few countries however have chosen to cover the weekend by asking the respondent about travel activities at both a weekday and a weekend day (the weekend day being randomly chosen). This way the weekend is covered by more interviews than in the case of an even distribution of the trips over the week. The downside is, as with other multi-day surveys, a higher response burden and risk of drop-outs, risk of memory recall effect and response fatigue resulting in less reported trips. The memory recall effect influences both the number of trips and characteristics of the trip, such as for instance the mode used.

One of the few countries which have used this method is France. In the old survey from the 1990s, a small reduction in the number of trips was observed for trips shorter than 40 kilometres due to memory recall effect or response fatigue. It has not been possible to observe a similar memory recall effect in the survey carried out in 2008. As France is using CAPI, the extra interview time is of less importance for the response rate. For the Austrian survey in 2013, two-day reporting has been used which resulted in more drop outs for the second day. As most respondents used PAPI to answer, the choice of a two-day survey is in conflict with the need to keep the survey very short for paper-and-pencil. It is therefore recommended to collect the non-working days

separately, unless special conditions are relevant.

In summary, it is possible to limit the survey to a representative sample of days, and then weight the results accordingly. This requires an analysis of the composition of the calendar, stratification and representativeness. In this case, it is important to notice the distinction between working days and non-working days, as well as seasonal and other variations.

In practice, a fully randomized, representative sample of calendar days may be very impractical for the planning and operation of the survey. Thus, the general choice is to select one or more series of days as the field period, which is not exactly a representative sampling. In most cases, transport authorities have a clear picture of what is a “normal” week, but the true question is whether the selection is representative, in order to scale correctly as yearly total.

Given a survey with coverage less than the 365 days, the data needs to be weighted/ scaled to the full year, using calendar representativeness assumptions. These assumptions will necessarily be a national issue, because the number of legal holidays and vacation periods differ between the MSs.

Certain MSs omit a few days from the calendar, for practical survey issues. This is unproblematic given that the surveyed days can be regarded as representative for the entire year.

Reference period

The two main travel survey formats are a one-day travel survey and a multi-day survey, the latter normally collecting diaries over one week (the British NTS and the German MOP). But there are also surveys with one weekday and one or two weekend days (the French NTS).

Most of today’s NTSs are one-day surveys. They have the advantage of being easier to complete for the respondents than multi-day surveys. The lower response burden enables to spend time on collecting other relevant information about e.g. retrospective travel behaviour or more details about each stage of the trips. The downside of a one-day survey is that only one-day journeys are reported in their full length. Either the outbound or the homebound trip of journeys lasting for more than one day will not be reported. Additional questions on the outbound and/or the homebound trip are therefore recommendable, especially a question about the starting date / ending date (for more details, please refer to the next sub-section on the choice of the travelling day).

Multi-day surveys on the other hand have the advantage of collecting information on more trips per respondent, including less commonly used modes like car-sharing and trip purposes. Having information on multiple days for one respondent also enables to characterise the respondents from their typical behaviour over a period (e.g. a ‘bicycle-rider’, an ‘inveterate car-rider’, a ‘mixed-mode rider’, a ‘few-trip person’, a ‘busy person’). It is furthermore possible to analyse variation in travel behaviour over a period, e.g. how often employees commute depending on the distance to work. The most important strength of a multi-day survey is however to obtain information on trips with overnight stays lasting for a few days. Similar to the one-day survey, journeys starting before the week or ending after the week are lost but an additional question on the starting or ending date will add important additional information on multi-day trips. This is especially relevant for knowledge about longer distance trips over 100 or 300 km. The downside of multi-day surveys is a higher risk or dropouts and higher costs. For this reason multi-day surveys are not conducted by a CATI. A memory recall effect and especially a reporting fatigue also impacts the amount of trips reported on different days during the multi-day survey. If memory recall effect or reporting fatigue is known and quantifiable, it is advisable to compensate for this by applying an appropriate weighting technique. For the same reason it is also important to rotate starting/ending day so that the same share of the respondents starts reporting on each weekday.

The effect on the cost of collecting data by a multi-day survey depends on the data collection methodology. The extra cost is lowest for paper-and-pencil surveys as is done for the German MOP. For a CAPI, the extra cost is higher. However, with the British solution where the diary is a paper-and-pencil questionnaire, the extra cost is less. The main balancing question is whether or not the gain of extra information per survey respondent (i.e. behavioural variability and the development of individual travel behaviour over an extended period of time) is warranted compared to the higher cost, additional respondent burden and the associated bias due to more refusals. With a given budget, the question is whether or not the gain of extra information

per respondent is warranted by a smaller sample and therefore less variability per day over the population and more uncertainty in the estimated indicators and other results.

If the interest is only to report the Eurostat indicators, the choice of a one-day survey is the recommended solution.

Choice of travelling day

In this sub-section, problems related to the decisions about which day and date the diary should report travel behaviour are discussed (mentioned as the travelling day). Furthermore, information on how a travelling day is limited, i.e. at what time it starts and when it is ending, is supplied.

The travelling day for each respondent should be chosen when the sample is drawn securing that each day during the year / interview period is covered equally. Furthermore, the travelling days should be distributed randomly over the sample. The travelling day is normally mentioned to the respondents in an introduction letter which often includes a 'memory jogger' to make it easier for the respondents to remember all trips. The memory jogger should include space to make a note for each trip about the address of the destination, the distance, departure time, time use, transport mode(s), purpose, etc.

In case of a CATI or CAPI, the interviewers try to obtain an interview the day after the travelling day. If they are not successful, two different main strategies are in use in the current NTSs. The one strategy is to try to get contact during the following days and ask for a diary for the chosen travelling day i.e. the travelling day is kept fixed. However, the longer the period after the travelling day passed, the more difficult it is for the respondent to remember the travel behaviour. If the respondent has filled in a memory jogger for the trips at the travelling day, the memory recall effect is smaller. The other strategy consists in focusing on the problem with the memory recall effect and therefore drop the chosen travelling day if contact is not obtained the day after. Instead, it is asked for a diary for the day before the day at which the interview is obtained, i.e. the travelling day is always moving to the day before the interview.

Due to the memory recall effect, some of the countries which are using a fixed travelling day move the surveyed travelling day by a week if contact is not obtained during the week. Others stop the attempt to contact when the period is getting too long. The contact period can be between 3-4 days (the German MiD 2008) and a month without changing the travelling day (the Finnish NTS).

In case of a CAWI or PAPI, the respondents can in principle complete the diary as long as they wish. However, normally a reminder is sent after a certain number of days. In this reminder, a new travelling day can be stated in order to reduce the memory recall effect. In case of a CAWI the survey can be closed for the respondent after a chosen period and an attempt to contact for a CATI or CAPI can start. The best will again be to choose the travelling day at the same weekday as for the original travelling day.

Only by choosing and keeping a fixed travelling reporting period is it possible to report travel behaviour representatively for the entire year. A new travelling day is normally not similar to the former. However, if the behaviour at the travelling day is independent of the contact day, the new reporting period is random, too. By moving the travelling day by one week, the distribution of travelling days over the week is furthermore representative. This is of course most important if the travelling day is a Saturday or Sunday, and especially a holiday; but Fridays and Mondays are different from other weekdays, too.

The important problem with moving the travelling day occurs when the reason why the respondent did not answer at the first day of call is that he/she was on a multi-day journey. In case of a long-duration journey this would normally be reported in a retrospective survey. More problematic is missing a short-duration journey in the local area with overnight stay(s) (e.g. a weekend visit to a vacation home) which is not included in a retrospective survey. When contact is obtained one week later, a more regular travel day may be reported and the day with an overnight stay is lost. If the respondent is contacted by mobile phone for a CATI, the chance to get contact on the right day is higher so the bias is smaller than was the case some years ago when most people only answered to surveys by landline phones.

Unfortunately, the different problems with choosing a travelling day are not investigated systematically. Based on experience, the best recommendations for the choice of the travelling day and reporting travel activity in case of a CATI or CAPI are the following:

- Choose a travelling day and include a memory jogger in the contact letter.
- Contact the respondent the following 2-3 days or perhaps a little longer for an interview about the chosen travelling day.

- In case contact is not obtained, move the travelling day to the same weekday a week later and try to get contact the following 2-3 days. Eventually, follow the same principle one more week later. When contact for an interview is obtained, ask if the respondent was on a journey with an overnight stay at the original travelling day. Should this be the case then ask a few questions about this journey (e.g. duration, destination, purpose and main mode). When doing this it is possible to report how many journeys with overnight stay(s) are lost by moving the travelling day and replacing it with a 'normal' day.
- In case the respondent starts the travelling day outside his/her home, ask which date the journey started. In case it started the day before the interview, ask if the respondent had had an overnight stay or if the respondent just arrived home late (e.g. after a night duty, a party or any other event). In case the respondent is not yet back home, ask when the expected return will be. If the journey included overnight stay(s), it is possible, together with information from the above question, to obtain an overview of the frequency of journeys of different durations during a year.

Another issue to be considered is the notion when a travelling day starts and when it ends. Considering a day starting at midnight and ending at the following midnight is not recommended. A travelling day has to start when the least people are travelling. The Guidelines for the Time Use Survey use a day start at 4 am[18]. Some of the current NTSs use 3 am. If a respondent has not returned home from an activity when the day ends the homebound trip is not a part of the diary for the travelling day and must not be included. In case they are included, there is an overestimation. On the other hand, it is important to get these early morning homebound trips included in an interview covering the following day as travelling day. In case they are not included the indicators are underestimated. Trips started before the turning point and not ended until later have to be included in the travelling day. More details are supplied in the example questionnaire in Chapter 6.

Use of incentives and other means to increase the response rate

The introduction of a survey to the potential respondents is of crucial importance for the response rate. The introduction letter has to catch the interest, emphasise the importance of the survey and make people feel responsible for correct answers. A travel survey is normally a popular survey because it does not include sensitive questions. It can be explained that the answers supplied are influencing transport investments and services. However, the importance should not be overstated as to prevent respondents to "invent" extra trips or change the transport mode used as to influence the importance of their favoured mode.

Another important purpose of the introduction letter is to make it clear that all travel modes are relevant, so that persons travelling by public transport, biking or walking do not feel that they are not relevant for a survey. It is of special relevance to explain that it is important to participate even if the respondent has not been travelling at all on the selected day. As a general inspiration for an increase of the response rate, the following points can be mentioned:

- The introduction letter has to be short and catch the interest from the first line;
- Public bodies as the sender work much better than a marketing company. Especially national statistical offices and ministries are more convincing. A signature or a citation from the national minister of transport may catch the interest;
- The availability of a website with more detailed information is important. Apart from explaining the purpose in more detail, it may include interesting results from former surveys and descriptions on how results have influenced the decision making (however, this should be done with caution as not to bias the answers that will be supplied);
- When contacting persons by phone it is important that the calling phone number doesn't appear as "anonymous". Furthermore, persons calling back following a missed call should get information about who has called and how they can get in contact and make an appointment.

A decreasing response rate which is observed in all countries is leading to new efforts to get the respondents to answer the survey. One method consists in offering incentives. Three different kinds of incentives may be offered:

1. One option is to offer the respondents to participate in a lottery if they complete the survey. This method

[18] http://ec.europa.eu/eurostat/ramon/statmanuals/files/KS-RA-08-014-EN.pdf page 108

is normally used by marketing companies to increase the response rate for their panels of respondents. The method is also copied by some public bodies conducting NTSs (i.e. in Denmark). Normally the prize offered has a value of 30 to 50 EUR. Dependent on the size of the survey the number of prizes can vary. For a NTS with a reference period of one year, the incentive can be offered as one or a few prizes per month. This could even be supplemented with a bigger prize by the end of the year. The type of prize depends on the sample size and on who are regarded as the most important to be attracted to the survey through an extra effort (e.g. the young aged 18-30 who normally feature a very low response rate). It is important to announce the names of the winners on the webpage of the survey so that the potential participants can see that the lottery is really taking place.

2. Another option would consist in offering a payment to everybody completing the survey. This kind of incentive can be paid in cash, by a cheque or as a gift voucher. The value of the payment should normally not be at the same level as a payment for the workload as this appears more appropriate for a survey with a more substantial workload.
3. A third option could include a small gift in the introduction letter requesting people to answer. The idea is that people who receive a small gift feel they owe something to the company/authority which has given them the gift. The gift can be for instance be a lottery coupon or a cheque for a small amount of money.

In case of a mix modes survey, for instance a survey using CAWI and CATI, as CAWI is the cheapest methods, the CAWI should be the first option to participate (to try to save some budget), it could be wise to offer a better incentive to those who participate with the CAWI. However, it is important to compare the cost of the incentive with the effect of attracting respondents to the CAWI instead of just answering to a following CATI.

When offering incentives one should be aware that the effect is biasing data: if the main target of the incentive is busy people in the high income segment, small payments are possibly not working and the effect of a lottery might be questionable, too. For this group the small gift might have the highest effect but it is important to choose the gift in the appropriate way, dedicated to the target group.

In 2015, the Dutch survey performed some trials with different kinds of incentives (see Box 2). One should be aware that memory recall effects and response fatigue might be higher for respondents who are attracted to a survey by an incentive then for those feeling a responsibility to participate due to the importance of the survey. Therefore, caution is needed when working with incentives, considering that an answer independent of the quality is better than no answer at all, especially in a travel survey for which a correct number of trips is crucial. The Dutch experience concluded also that an incentive paid to the sample with the introduction letter attracted more respondents from groups which already had a high response rate and was not working for those with a low response rate. Therefore, one might state that the response rate increases but becomes even more biased. Some general recommendations for incentives could be:

- Small incentives for participation in a CAWI (e.g. a lottery);
- No incentive for participating in a one-day survey as CATI;
- Small incentives for participating in multi-day surveys and panel surveys;
- Incentives paid in advance should not be used because they do not change the participation behaviour.

Two Dutch experiences with incentives in 2015

As a pilot, a 5 EUR cheque was included in the introduction letter. Thus, persons obtained this incentive whether they would respond or not. It turned out that the response through the Internet increased from 18% to 37%. During the follow-up by CATI or CAPI (if the telephone number is unknown) among persons not responding through the Internet, the response rate was also somewhat higher. It did not work well for all person groups, e.g. persons of non-western origin or persons with a low income did not respond much better. Overall, a better response was obtained from groups of persons which were already among the best respondents.
The mobility indicators were also evaluated. They were the same: the same share of people without a trip, the same number of trips, etc.
Another pilot tried to raise the response rate with a lottery offering an Ipad as a prize. Participants had to finish the web / CATI / CAPI interview in order to be able to participate in the lottery. This also increased the web response, but at a much lesser degree. However, the younger age groups reacted well to this.

4.6 Data collection protocol for retrospective surveys

Some travel activities are not very frequent and therefore not easy to catch with the needed precision in a cross-sectional survey, as described in Section 4.5. In general, the longer and/or the more expensive the journeys are, the less frequent people are travelling. Consequently, there is a need to collect data for a longer period to obtain enough observations for the intended precision. This can be done in two ways: as a cross-sectional survey running over a long period or as a retrospective survey (Axhausen et al., 2003). The British NTS and the German MOP collect a diary during a week and therefore collect more journeys but still not enough time to cover low frequent journeys. In this section the interest is however with the retrospective survey in which the respondents are asked to remember their journeys over a period back in time.

The length of the period to be included in the retrospective survey depends on two questions: the frequency of the journey and the memory recall effect, i.e. how far back in time the respondents are able to remember. The less often a journey is, the longer the period needs to be to collect enough journeys. However, travel activity is not equally distributed in the population. Few people are travelling very often and therefore represent a high share of all journeys. In case a long reference period is chosen to collect the low frequent travel activity, some respondents should report many journeys while most of the rest have no journeys or only very few. For those with many journeys response fatigue should also be considered when planning the survey. The three important rules to be taken into account when planning retrospective surveys are therefore:

- Collect information through a retrospective survey for a long enough period to find sufficient respondents who are travelling;
- Keep the period as short as possible to minimise the memory recall effect and organise the survey in a way that it is possible to compensate for the memory recall effect afterwards;
- Treat high-frequent travelling respondents such that the respondent burden is reduced to a minimum.

Recommended procedure

From earlier experience and especially the EU 7th framework project Kite, a couple of possibilities to reduce the effect of response fatigue and to compensate for the memory recall effect are suggested (Frei et al., 2010).

- If the respondents from the beginning were asked about the number of journeys during the last three months (best month-by-month) the risk of response fatigue is reduced because the interviewer knows the sum and can insist on getting more information.
- If the number of journeys is higher than a certain level (e.g. 6), the survey should include a question if other journeys have been similar to the trip that has just been described. In case there have been similar journeys the respondent should only be asked how many similar journeys have been made. By “similar” is meant the same destination and transport mode used. Furthermore, the respondent

should only be asked about details for 6-8 different journeys.

- To be able to compensate for the memory recall effect the respondent has to be asked for a precise date for the end of the journey and for the latest journey before the response period. With this information (and the duration of the journey) the time distance between consecutive journeys can be calculated and a model for the time distance between the journeys for all respondents can be estimated. This calculation can be used for up-weighting the overall number of journeys and travel distance to a full year level without a memory deficit. The precise date might not be easy to remember for the respondents, but information about which week the journey ended is sufficient for journeys more than a month back in time. A calendar also listing official holidays might help to remember the right date or week.
- It is recommended to only collect information about the final destination, the mode used, the purpose and duration of the journey, the number of accompanying persons, and -if the journey is no longer than 300 km one way– the distance to the final destination. For medium- and long-distance journeys, the distance is calculated to a city or to the midpoint of a NUTS 2 level (NUTS 3 or 4 levels for domestic journeys) because the calculated distance is probably better than the reported one.
- To avoid an overload of the respondents, it is suggested only to collect details about each trip for one journey, preferably the latest one.
    - For domestic journeys it is recommended to collect information about all trips by stages for the trips from home to the first overnight stay at a place with a purpose/activity; and for the trips back home from the last overnight stay at a place with a purpose/activity. This place can be the main destination of the journey. But it can also be the first/last stay of a round-trip.
    - For journeys crossing international border(s) it is recommended only to collect detailed information about trips by stages to the first destination after the first border crossing and the last trip that included a border crossing back into the country of residence. In case of an overnight stay underway at a destination with a purpose/activity in the resident country, it is recommended only to collect information about trips by stages to this destination.
    - To reduce the burden of the respondents, information about stages can be reduced to only stages longer than 10 km or to only motorised vehicles (except if the main mode is non-motorised).

Possible alternative methods

- Medium- and long-distance travel surveys are time-consuming and therefore difficult to combine with a cross-sectional survey if it is not conducted as a CAPI. A separate survey on the other hand is costly and needs to run over a year to take into account considerable seasonal variations.
- An alternative to the above described traditional retrospective survey could be a more simple survey following
- The end of the cross-sectional NTS. The respondent could be asked for one one-day journey longer than the decided threshold and one journey with overnight stay(s).
- Another alternative method to collect data for the medium and long distance travel indicators is to use the tourism demand survey which includes the main information needed for the indicators. However, detailed information about destinations needed for the calculation of distances would be missing. The survey only includes the country visited for journeys abroad and regions at NUTS 2 level for domestic travel, whereas more precise destinations are needed (NUTS 2 level in foreign countries and normally NUTS 3 level for domestic trips). The tourism demand survey is normally quite long and elaborated, making it difficult to accommodate the request for more detailed information.

4.7 Data quality: processing and provision

Details on how data should be treated and which consistency checks should be performed are presented below.

Weighting and imputation

Weighting and imputation are used to compensate for unit non-response (respondents not participating) or item-non-response (questions not (fully) answered).[19]

Weighting

Weighting consists in assigning a weighting coefficient to each household or individual questioned. The purpose is to compensate for i) biases in response rates and ii) non-proportional sampling iii) inadequacies of the sampling frame and iv) bringing data up to the dimension of the reference population. Margin calibration with official population statistics, censuses etc. are the most commonly used weighting procedure for European NTSs. The method provides a weight depending on the included variables and the sample frame of reference and stratification, if used. It allows rectifying survey results by adding a weight to each respondent, using auxiliary information available on a certain number of variables, called calibration variables. As a minimum it is recommended to include the following variables, which are also the easiest and most common calibration variables to include:

- Age
- Gender
- Day of week
- Spatial distribution of the population by region and city size

Other relevant calibration variables to include in a weighting procedure are:

- Household size, especially when using a household sample
- Marriage status
- Education
- Job status
- Ethnic background
- Car ownership

In case of a one-day survey with an individual sample only person weighting is needed. In case of household sampling both household and individual weights are needed. In case of multi-day surveys trip weights are needed. For retrospective surveys a weighting coefficient is also needed for each trip/journey to compensate for memory recall effect and/or response fatigue.

Some countries furthermore use a post-stratification in which the first settled weights by marginal calibration are made more precise. The adjustment involves replacing initial weights by new weights so that, for each variable used for calibration, the numbers of the modalities/values of the variable estimated in the sample after weighting are equal to the numbers known for the reference population.

A multi-stage procedure is possible following this approach:

1. Computation of weights to compensate for unequal probabilities of selection
2. Adjustment for non-response
3. Post-stratification of the sample weights to sample frame

A weighting method enables reducing the variance, and thereby improving the accuracy of the results obtained. The Netherlands is the only country using external data, in particular the number of vehicles per household, the overall car fleet, and more advanced demographic data. Analyses of earlier Danish data show that

[19] This section is mainly a copy from the Shanti project (Armoogum et al., 2014).

marriage status and car ownership are the two variables with most influence on the travel indicators. However, in case data are used for modelling car ownership in the population, a weight including car ownership should not be used. But this can be solved by using different weights for reporting indicators and for modelling.

Imputation

Imputation can be used for compensating for item non-response, e.g. missing information about education, job-status or income of the respondents and mode, purpose or distance for trips. Imputation is defined as “the replacement of the missing data by one (or several) given observations deducted or calculated based on information obtained for the failed unit and / or units that are close to him”.

Imputation can be inferred by:

- Direct calculation from other information on the same unit;
- Formalised relations generally estimated by regression on the complete observations (e.g. speed depending on the distance to impute duration);
- One (or more) "donor(s)", i.e. one (or several) observation(s) whose characteristics are similar, which is closer to the incomplete observation.

The objective of the imputation procedures is to obtain a complete data matrix (in this case we talk of "clean *data matrix*"). This is especially useful when multivariate analysis cannot be achieved on data with missing values. The disadvantage is that it may bias the relationship between variables or complicate the calculation of the quadratic error of the corrected variable without necessarily bias estimates of totals for this variable.

It is therefore very important not only to adequately describe all the imputation procedures used but also to create dummy variables, called "flags" that will score in the imputed data file. This will leave the option to the statistician to judge the influence of the imputed data and change the imputation methodology if necessary, but also to take this into account when calculating confidence intervals.

Data consistency checks during the survey

When collecting data by a computer-assisted programme (CATI, CAPI, and CAWI) it is possible to make consistency checks during the survey. Some of the recommended checks are:

- Is the respondent answering to all questions? If a question is left open the survey can be stopped until the question is answered (strong warning) or the respondent can be asked to answer but no answer or ‘don’t know’ can be accepted (a weak warning).
- The speed can be calculated and controlled together with the travel mode. Both too slowly and too fast should result in a warning. In case a respondent is not able to answer to the question about distance it might be possible to help based on travel time and mode.
- In case a trip by public transport starts or ends without an access or egress mode the respondent should be asked about this mode.
- Check of age and gender (especially if it is known from the sample), this check is useful to be aware if a wrong person is answering to the survey.
- Check information about income, especially if it is very high, make a warning.
- A check of the chosen destination together with the travel distance is a very valuable consistency check. If all addresses (or zone midpoints) are known by coordinates the Euclidean distance between departure and destination coordinates can be calculated. In case they are too short or too long compared with the informed distance, the respondent should be warned. It is the Danish experience that the difference is often due to a wrong registration of the destination. A correction of this mistake is very important for the right registration of urban trips.

Control during the survey reduces the need for imputation and improves the quality of the data. When questions are not answered it is most often due to mistakes and therefore a hard warning is important which means that the interview cannot go on without an answer. However, some questions might be sensitive (e.g. about income) and the risk is that the respondent interrupts the interview. For these questions it might be better to use a weak warning making it possible to continue without answering.

After-treatment including consistency checks

An important after-treatment is to check the number of trips and the share of non-trip-makers reported from each interviewer. A higher share of non-trip-makers by age-band, especially combined with a low number of trips per trip-maker by age-band compared with the rest of the survey could be a clear evidence of a bad performance of the interviewer. If an interviewer has a low performance it is extremely important to react immediately with a warning. In rare cases where the performance is not improved, the interviewer should no longer carry out interviews.. Similarly, other quality checks of the data collection should be performed regularly. Experience shows that a survey company or their interviewers show decreasing performance if they are not monitored closely. Even the best companies are failing!

In the after-treatment incomplete addresses should be corrected based on written information from the respondent. New addresses should be added to the address database including coordinates etc.

MSs are suggested to use three types of data consistency checks when collecting data through NTSs. Firstly, internal checks as mentioned above should be conducted if they cannot be made during the interview. An important check to be added is if a trip is cut into several trips at places which indicate that the “trip” is a stage, e.g. a trip ending at a station. In case a trip is reported as stages, the stages have to be "glued together” to make it a trip.

Secondly, internal data consistency checks of the calculated indicators should be asked to be performed before delivering data. Examples of such checks are:

- pkm = vkm x occupancy rate
- urban mobility + non-urban mobility = total mobility (<300km)
- short distance mobility + medium distance mobility + long distance mobility = total mobility
- the totals for different break-up variables are the same
- etc.

Thirdly, external data consistency checks can be considered. With external data consistency checks, use is made of external (third party) databases that (may) also contain passenger mobility information or vehicle mobility information. Examples of databases that may contain such information are:

- Annual kilometres by passenger cars calculated based on odometer reading
- National fuel consumption of petrol and diesel
- Vehicle registration databases
- Vehicle insurance database
- Tourism statistics

Non-trip-makers and varying number of trips / journeys per respondent

No-trip-makers

A comparison of indicators from 12 European NTSs conducted in the period 2005-2011 shows that the share of respondents without a trip (no-trip-makers) varies between 9% and 28% across travel surveys in Europe (Christensen et al., 2014). It seems unlikely that this outcome reflects real differences in behaviour across the countries.[20] Instead, Madre (Madre et al., 2006) concluded – based on analyses of many regional and national surveys with different methodologies – that the real share of the population without trips for a one-day survey *at weekdays* is likely to be in a range between 8% and 12%. Five of the European one-year-NTSs end up with a share of no-trip-makers of 15-16%. This higher share is possibly due to the inclusion of weekends and holidays. Weekends alone can explain 2-3%.

Previous research suggests that the observed proportion of no-trip-makers in a survey is very sensitive to applied methods of data collection. Christensen (2006), for example, investigated the proportion of no-trip-makers in the Danish NTS from 1998 to 2001. During the 4-year period the share of no-trip-makers increased

[20] The following is cited from a revised but not yet published version of (Christensen et al., 2014)

from 15% to 25%. Besides declining interviewer performance (the most important explanation), there was evidence for the share of trip-makers being dependent on several other methodological factors such as time of the day and day of the week when respondents were contacted or the number of recalls in case of a prior appointment.

(Christensen et al., 2014) lists the following reasons for differences in the share of no-trip-makers:

- Madre et al. (2006) and Christensen (2006) concluded that soft refusals, i.e. respondents reporting no trip as a way to get quickly finished without denying responding, might increase the share of respondents without trips.
- The share of respondents without trips might also be related to a memory recall effect that causes low-key travel events (e.g., short walks) being forgotten if the time gap between travel day and interview is too long.
- In a multi-day survey the share of respondents without trips might also be related to response fatigue in the later days of the reference period due to the interview burden (see below for the British experience).
- With a self-administered questionnaire the share of respondents without a trip can also be due to memory recall effect or because the respondent is not aware if short trips should be included or not. In an interviewer-administered interview the trip rate is higher for the shortest trips probably because the interviewer reminds the respondent about the short trips (Christensen, 2012).
- It is also likely that specific methodology features result in a decreased share of respondents without trips in a survey, for example, if potential respondents with low mobility (i.e. potential respondents without trips) consider themselves not relevant for a travel survey.

The British experience with response fatigue

The number of no-trip-makers in the British NTS increases over the seven days diary. When referring to day 1 the share of no-trip-makers is only 15-16%, which is in line with both a Greater London survey and five other European NTSs. When referring to day 7 the share of no-trip-makers is 22%. Day 7 is the only day for which mode information is collected for walking stages. Source: Unpublished analyses made by Melbourne & Dickinson on English NTS data for 2008-10.

Experience with the German MOP and MiD 2008

Indication for potential respondents considering themselves irrelevant has been found in the German MOP for which the share of no-trip makers is only 9% (Wirtz et. al. 2013; Chlond, Wirtz & Zumkeller 2012; Kuhnimhof, Chlond & Zumkeller 2006). A comparison of the MID 2002 and the German Time Use Survey (TUD) from 2002 shows a share of no-trip-makers of 13% in both surveys (Gerike et al., 2013) which indicates that the MID 2008 with 10% has a too low share of no-trip-makers. The comparison with the TUD is interesting because respondents to the TUD are not considered to avoid reporting trips as a soft refusal strategy. A very short data collection period might be an important part of the explanation.

Respondents who are contacted for participating in a NTS may use different strategies if they do not want to participate. One is just to reject when they are contacted by an interviewer or to throw away the questionnaire in case of a PAPI. Another strategy is the so-called soft refusal at which the respondent pretends to participate but denies by only delivering very few answers. A soft refuser is often busy when contacted and therefore postpones the interview by making an appointment or asking the interviewer to call later. This might happen several times. If the interviewer is very eager and calls back several times the soft refuser may change strategy and instead accept to participate and pretend not to have had any trips on the travelling day. It is always a bit suspicious if a respondent makes several appointments and therefore seems to be busy but in the final end has not been travelling. However, it cannot be proved that the result is wrong. It can be seen statistically that the share of no-trip-makers is higher among respondents who have been contacted several

times without completing an interview. Afterwards it is impossible to identify the soft refusers between no-trip-makers and therefore to correct for it.

A good way to reduce the effect of soft refusal is not to contact the respondent for an interview more than 2-3 times if an appointment has been missed. For respondents who have not answered at all it is acceptable to try more times or to take up the attempt to make contact later because the respondent may be on a long duration journey. With knowledge of cell phone numbers this effect might be smaller nowadays than earlier.

For detecting soft refusal, the question “why did you stay at home yesterday?” is not very useful, as most people answer that they did not need to move.

For example, in the French 1993-94 NTS, considering as ‘soft refusers’ those who gave this answer for the last Saturday and Sunday, as well as for the day before would have reduced the rate of immobile persons on a week day from 15% to 12%. In the 2007-08 French NTS, people were asked if they stayed at home (or in their garden) for each of the 7 days before the visit of the surveyor. The 15% of individuals who declared that they stayed at home the day before his/her visit (from Monday to Friday) were asked to describe the most recent week day when they had made trips, which was done by 11% of them, while 3% stayed at home all 7 days and 1% moved only on Saturday or Sunday. The 11% who described their mobility for a day earlier than initially allocated made 21% less trips (maybe due to memory effect) but the distance travelled didn’t differ significantly. Concerning the reasons given for immobility, 20% of those who didn’t move from Monday to Friday mentioned that it was due to a temporary incapacity (illness, pregnancy, etc.) and 24% for a permanent disability. For Saturday and Sunday, three reasons of immobility were coded; for the first reason, 62% was “no need to move” on Saturday and 74% on Sunday. However, a more meaningful response (incapacity, weather, activity at home, no car or driver available) was given as second reason by 11% of immobile persons; but the third reason did hardly bring more information.

Thus, asking for mobility/immobility over the last 7 days and for a description of the most recent mobile day seems operational for avoiding soft refusal. This method would be less sophisticated than that proposed in the Netherlands, which relies on the availability of a panel survey (de Haas et al., 2017).

Number of trips and quality problems

The number of trips per respondent is also varying substantially between the respondents in the European NTSs. However, when calculating the number of trips per respondent who has made a trip, the variation is much smaller: between 3.24 and 3.89. The result of soft refusal could also be fewer trips than correct which is even more complicated to reveal during the interview or to identify afterwards. A decreasing number of trips per trip-maker over time is unfortunately observed in many NTSs. In (Christensen, 2004) it is shown for Denmark that the number of trips per trip-maker was decreasing together with the number of trip-makers in the period 1998-2001. Again, the main explanation was the decreasing quality of interviewer performance but the effect is smaller than in the number of trips. (Ortúzar et al., 2011) is reporting problems with several surveys with decreasing data quality due to decreasing performance of the interviewers and reduced motivation from the staff. Such problems often result in interruption of the survey and data loss, e.g. in Denmark the continuous NTS was stopped in 2004 due to quality problems. From 2006 it was taken up again, focussing on quality demand and continuous monitoring of each interviewer. However, even then in each contract period, decreased quality with a lower number of trips has been observed. In Sweden similar problems have also resulted in a break in the continuous survey from 2001 (Ortúzar et al., 2011). In 2004 Ortúzar describes with an example from Santiago de Chile, at a conference in Costa Rica, how important it is to follow up on the interviewers and how to encourage them to be painstaking with the information collection during the interview. But a few years later the Chilean survey ended up with low data quality too due to less and less control from the staff and therefore decreasing performance from the interviewers.

Denominator share of trip-makers

It is evident that survey methodology specifically influences the proportion of trip-makers in a survey. It impacts on it in various – possibly counteracting – ways that currently can hardly be quantified. This impact varies from survey to survey. This renders per capita travel indicators, i.e. indicators where individuals without trips are part of the denominator, often incomparable across surveys. Because the impact of survey methodology on the share of trips currently cannot be quantified, it can hardly be corrected with approaches

such as common denominators and weighting, but nor should it be ignored. Therefore, it is a viable method to harmonise surveys ex-post to revert to the original denominator for which travel data was captured, i.e., to use trip-makers as the denominator and generate travel indicators per trip-maker (and not per capita).

It is acknowledged that this being a “sledgehammer method” which is likely to eliminate much (but not all, especially not in case of high shares of no-trip-making at which some short trips normally are left out, too) incomparability across surveys caused by methodology. Nevertheless, it is currently unlikely that there are more appropriate measures to achieve at least some comparability.

Response fatigue and memory recall effect

Response fatigue means that the respondents do not bother to go on answering quite as carefully as they did in the beginning. They will give less correct answers about each trip and/or they will leave out trips. Some respondents stop answering, resulting in an interrupted interview.

Memory recall effect means that the respondents forget information. First of all they forget trips. They might also forget which mode they used and state a wrong mode. Pilot studies with GNSS logging in parallel with a traditional diary also show that respondents have stated a trip to take place at another day than it really did. Memory recall effect is more often observed in interviewer-administered interviews than self-administered interviews because the respondents get less time to consider their answer. But there is no single answer to that because an interviewer can also remind the respondent of trips or situations which make the respondent remember something.

Both response fatigue and memory recall effect is mentioned in several sub-chapters of these guidelines with discussions about the problems and actions for reducing the effect. This said, the effects cannot be avoided but hopefully reduced if one is aware of the problems.

Response rate and response bias

The response rate is an important indicator for data quality. The MSs are therefore asked to report the response rate for the survey they have conducted and deliver Eurostat the quality indicators (see Section 2.5). However, it is important to be aware that the response rate in itself is not saying everything. As described above the responses can be more or less biased and the bias might be more important than a high response rate in itself (Groves, 2006). As shown by the Dutch pilot project with incentives (see further above) a higher response rate is obtained from groups which usually have a high response rate leaving those with a low response rate left back with an even lower share among the respondents. In case they have a different travel pattern than the main group, the resulting travel pattern is less representative for the population than it would have been without the incentives.

Some kind of bias can be compensated by reweighting (see Section 4.6), e.g. different response rates from age groups, gender and household sizes. Others cannot be compensated, and most problematic are those related to travel behaviour which can be both very active and very inactive persons. Busy persons have been mentioned several times in the text. But one should also be aware of other groups with a lower response rate than the average and who might have a special travel pattern, e.g. low-income persons, unemployed and those outside the labour market due to their social or health situation, non-western emigrants, disabled and sick persons.

The day of the week and the season also play an important role, especially if the travelling date has been moved from the original chosen date. If people were travelling and did not answer to the survey in due time and their interview is moved by a day or a week, they might be little active at the new travelling day. Weighting can compensate for differences in travel day over the week.

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5. Method of ex-post harmonisation of existing national survey results

5.1 Introduction

This section offers a short overview of the different post-harmonisation methods that may be considered as a result of information that was previously collected in Member States in relation to survey design as well as the effective collection of passenger mobility data parameters. The main focus of this exercise is to identify general ex-post harmonisation strategies. Existing differences and similarities between Member States' data collection practices and existing differences and similarities in relation to specific passenger mobility indicators are reported in Annex 2. These can for instance be specific indicators collected, the method by which they are collected, and how variables are grouped.

5.2 Ex-post harmonisation methodologies

As a result of the work done in the COST/SHANTI and OPTIMISM projects, three different harmonisation methods could be identified that help enhance comparability of data between countries or over time periods.

The first method consists of returning to the *original micro-data* that are not grouped in a specific format (if available). These data may then be reworked/ regrouped to fit a common accepted grouping format. The grouping as such can be done either by the original owner of the data, or if micro-data are publicly available, by a third person (non-owner).

The most important advantage of this method is that any commonly accepted grouping can be used, meaning no specific grouping history poses a practical limit and a common grouping that is best suited in terms of information contained can be decided upon. A possible disadvantage of this method is that it may be a time-consuming and costly process, depending on the size of the database. A clear communication with the data owners is needed.

A second method consists in finding the *common grouping denominator* across different data sets (Member States). In practice, this means that the grouped data in itself is regrouped to fit the largest overlapping categories across data sets (Member States). For example, age groups "70-79 years old" and "80-89 years old" and so on are regrouped in one group called "70 and older".

The most direct advantage is that the already available information can relatively quickly be re-used to estimate totals. For the estimation of averages, this assumes that a clear weighting of each underlying category is possible when averages need to be prepared. In our example, this would mean that it is known how many people are in each age category in the sample. The most important disadvantages are that the "largest overlapping category" as such can become very broad, and loses particular meaningfulness for mobility analyses.

A third method involves the *weighting of existing data categories* in order to approximate or estimate values for a common classification. In some cases it may simply not be possible to find a common overlapping categorisation. For example, the targeted age group "70-79 years old" may not be directly available through original micro-data or existing grouping ("66-75 years old" and "76-85 years old"). In those cases, a weighting procedure must be created that allows for the estimation of the mobility impact of persons aged 70 to 79 years old in the "66-75 years old" category as well as the mobility impact of persons aged 70 to 79 years old in the "76-85 years old" category. Weighting procedures can be based on principles outlined in available literature, comparable countries who have detailed micro-data available or arithmetic functions assuming proportionate (all ages have a similar mobility pattern) or disproportionate impacts (mobility declines with age).

The advantage of the weighting procedure is that it may provide added insight in the mobility patterns of different categories of mobile persons. The main disadvantage of weighting procedures is that it may introduce unwanted biases in the data (for example when wrong or unsubstantiated assumptions on distributions are made).

Each of the methods can be considered for the different parameters for which data is collected and for which

a variety of ranges and groupings is used.

An option for collecting indicators from existing NTSs could be that the MSs deliver a micro-dataset including the variables needed to construct the wanted tables in a specific format with the grouping of all variables as far as possible in accordance with the definitions in Chapter 2.

Within this context, please note that the use of the mentioned harmonisation methods also depends on the nature of the origin of possible harmonisation requirements. A distinction can be made between harmonisation issues that exist as a result of a strictly methodological difference between data collection practices (different collection method, different timeframe, different periodicity, different sampling method, etc.) and harmonisation issues that may exist because of a different grouping of passenger mobility data across parameters.

Finding a harmonisation solution for data that is not comparable as a result of survey methodology differences is relative difficult. As a consequence, clear descriptions need to be made of how the methodological choices made affect validity of data that is collected for a sample population in a specific period compared to the entire population or a larger time period. For example:

Choosing the sample population based on national phone registries may present a bias in the sense that people who are not present in such a register (i.e. persons without a land-line connection : poor population, “only cell-phone” owners, etc.) are not represented in the sample.

- Choosing the sample population based on age restrictions may lead to a bias towards the working population;
- Choosing a time frame period of one month in the year may lead to seasonality biases.

In order to compensate for the possible introduction of such biases, it is sometimes necessary to make use of additional information from other studies (in other domains of research) or other, more complete, data collection exercises. Based on such additional information, it may be possible to estimate the bias effect size and compensate for such biases.

Finding a harmonisation solution for data that is not comparable as a result of different grouping of passenger mobility data across parameters requires a different approach. By and large, this supposes that data sufficiently valid for the entire population is collected (or, following the methods proposed, has been calibrated to be more valid for the entire population) but that the reporting of the data is done in a different way across Member States. For example:

- Countries may choose to report passenger kilometres for different vehicle type groups. One country may limit itself to the categories of “passenger cars, trams & metro, train, bus & coach, cycling and pedestrians” while another country may choose to make a distinction between “passenger cars, trams, metro, regular train, high-speed train, stage bus, express bus, coach, cycling, pedestrians and other transport modes”.
- Countries may choose to report passenger kilometres for all different ages on a year-by-year basis (in effect, age as a continuous scale) whereas other group ages over decades (<14 years old, 14-19 years old, 20-29 years old and so on).

To allow for possible post-harmonisation of national survey results in order to render them comparable with other national surveys is it therefore recommended to collect and store in micro-data as many parameters as possible (respondent's age, travel distance and travel time, etc.) using the continuous scale.

The use of a series of Excel tables to be completed by all countries to ensure the correct interpretation of results and the coherent calculation of the required indicators is proposed.

6. Mobility questionnaires - recommendations

6.1 Introduction

The purpose of mobility questionnaires is to provide a basis for the calculation of the Harmonised Mobility Indicators as defined in Section 3.

The mobility questionnaires are of great interest also for national policy/statistical needs. Generally, the questionnaire contains a large number of features due to quality considerations and it is necessary to implement most of these to obtain reliable results of good quality.

This chapter of the Guidelines contains recommendations on survey design, in order to assure reliable and high-quality results. Countries are nevertheless encouraged to design their questionnaires according to national circumstances. Sample questionnaires from several countries are available in Annex 3.

Furthermore, this section contains some elaborations on methodology, mainly because survey design issues and questionnaire design issues are deeply related.

One or two surveys

It is possible to conduct the survey as one single survey or divided in two parts, with the urban/short-distance (daily) survey as one part and the medium/long-distance (retrospective) survey as the other.

One important point is that the medium/long-distance survey part only exists because of the low basic frequency of these trips. This may be an irrelevant consideration if the one-day survey contains 100 000's or even millions of interviews. However, as the recommended and most common survey size is approx. 10 000 interviews, more observations are necessary for the medium/long-distance trips, which is the basic justification for the retrospective questionnaire.

Key arguments for conducting the survey in two parts:

- To keep the interview time / respondent burden at a reasonable level;
- The two parts have very different requirements on the calendar representativeness – the one-day survey requires that the survey is representative for the 365 days of the year, whereas the retrospective medium/long distance survey requires the months;
- Because of the calendar difference, the two parts have very different requirements on the sampling, practical arrangements and general management of the survey(s);
- The retrospective medium/long distance survey might be combined with the Tourism Demand Survey.

Key arguments for conducting the survey in one part:

- One sample, one recruiting procedure;
- Joint set of background questions saves total interview time and costs;
- May be easier to manage;
- Possibility to analyse the interaction between urban/short and medium/long-distance mobility;
- If the survey is large enough (>100 000 interviews), the retrospective part can be reduced to very few questions, because the one-day dataset might provide enough observations for most of the indicators.

The decision on whether to combine or not combine the two parts is left to the MS, with the stated remarks.

6.2 Background questions

The section containing background questions is common to the one-day and retrospective surveys and is placed before or after the core of the questionnaire.

Most of these background questions are not strictly necessary for the Harmonised Mobility Indicators. However, they are included in the questionnaire for the reason of weighting, filtering or phrasing issues and also for national applications.

Some of these questions are also relevant due to quality considerations, as this further allows quality checks such as “non-driving licence holders are driving a car”, “pensioners going to school”, etc. Strictly speaking, these combinations are not necessarily wrong, as they may be true. However, they should draw attention in the post processing even more, as errors often come in bundles.

If the data collection is split into two surveys, the background questions may be different in the two parts.

Question: Home address

Minimum requirement: Coding at FUA/non-FUA level. This is needed to calculate the urban indicators, as criterion whether the respondent resides within the urban area or not.

Recommendation for ease of response: Coding as actual address in text. This is used to refer to the same place later in the interview (the home address generally has multiple visits).

Recommendation for weighting needs: Coding as census tract or other reference to population statistics.

Recommendation for quality considerations: Coordinates or similarly detailed information, which is applicable for distance calculations in the questionnaire.

Recommended for national applications: When coordinates are available it is possible to derive a set of explanatory variables, such as “distance to nearest station”, “degree of urbanisation”, etc. These variables may then be used for analysis of travel behaviour dependent of geography.

Question: Year of birth (or age)

Minimum requirement: Filtering to correct the age group. This may be done in the recruiting procedure.

Recommended for ease of response and quality considerations: Age affects various later options in the questionnaire.

Recommended for weighting needs: Reference to population statistics.

Recommended for national applications: Analysis of transport patterns dependent on age.

Question: Gender (sex)

Recommended for weighting needs: Reference to population statistics.

Recommended for national applications: Analysis of transport patterns dependent on gender.

Question: Education level

Recommended for national applications: Analysis of transport patterns dependent on the level of education.

Question: Primary occupation / employment situation

Asking for the primary occupation is a key question: the value is used for filtering and verification of other questions. However, the primary occupation is not directly part of the indicators, but may be used for national applications.

The primary occupation is indeed an application of age as filtering/verification criteria. Not all combinations of age and primary occupation are possible. Please note that some combinations are possible but could be illegal.

Recommended for questionnaire considerations: The primary occupation acts as filtering criterion for the workplace/school address and possible national additions.

Recommended for quality considerations: Quality checks such as the frequency of "unemployed/pensioners with working place as destination" and similar considerations.

Recommended for national applications: Analysis of transport patterns dependent on the primary occupation.

Suggested response options based on the Labour Force survey list LFS (see page 113), with relevant national additions.

Question: Workplace/school address

Conditional on primary occupation.

Recommendation for ease of response: Coding as actual address in text. This can be used to refer to the same place later in the interview (if the address generally has multiple visits).

Recommended for quality considerations: Comparison/benchmark of results with commuting statistics. Crosscheck questionnaire data: "workplace visited for other purpose", "other places visited as workplace purpose".

Recommended for national applications: Analysis of commuter patterns and generally the interaction between the transport sector and the labour market.

Possible national additions:

- Type of workplace, commuting days per week, car-parking possibilities at home or workplace, most commonly used mode for commuting, household size and composition, dwelling type, income, etc.

- The **household size** may be necessary for the weighting procedure. In this case, it is a national minimum requirement.

- The **income** should be of particular national interest, as it is generally the most significant explanatory variable for transport patterns (even if spatial characteristics are gaining importance).

Question: Number of cars available to the household

Recommended for ease of response and quality: During the interview, it is easier (and less burdensome) for the respondent to answer which car of the household was used, instead of the fuel type for each car trip.

Cars question block: identification and fuel type for each car

For each car, fuel type and identification are required, such that the respondent would be able to recall the car later in the questionnaire. Identification could be colour, model, or any other characteristics known to the respondent.

Response options for the fuel type should be the categories from Section 2.2. Due to emerging technologies and national differences, these categories are likely to be revised.

Recommended for ease of response and quality: During the interview, it is easier (and less burdensome) for the respondent to answer which car of the household was used, instead of the fuel type for each car trip. This information is required for statistics by fuel type (urban/short indicators 3c, 5c).

Alternative approach: Ask for the vehicle registration number and permission to seek the fuel type, power, mileage of car at last control, etc. from the vehicle registry. This may require permission from the Data Protection Agency, to combine survey and register data.

Question: Possession of driving licence / bicycle / moped / other means of transport

Recommended for quality considerations: Crosscheck questionnaire data “Car drivers without licence”, “moped drivers who don’t own a moped” and more. All of these are physically possible, but this kind of combinations should draw attention in the post processing and checked for potential errors.

Recommended for national applications: Statistics on e.g. bicycle ownership. Analysis of transport patterns depending on available modes.

6.3 Model questionnaire for the one-day/cross-sectional survey

The basic concept is that the urban and short distance indicators are calculated from a series of interviews according to “one person, one day”. This requires that these interviews are managed to be representative to both dimensions, calendar and population – single dimensional and in combination. Please refer to Section 4 for further details.

Regarding the questionnaire, the quality relies of course on the answers provided. Experience has shown that data from an uncontrolled questionnaire leads to severe biases on the results.

The questionnaire core is the rhythm **destination** > **trip** > **destination** > **trip** > **destination.** The respondent repeatedly provides information on where he/she went and how he/she arrived there.

Initial question: address/destination at the starting point of the day (destination 0)

The question should be phrased with a precise time during the night. This “day split time” should be chosen as the time during the night with the least travel activity / largest proportion of the population at home. This is dependent on national traditions and habits, but a typical value is 03:00.

Minimum requirement: Coding at FUA/non-FUA level. This is needed to calculate the urban indicators, as the value is part of the criteria whether the first trip is within the FUA or not.

Possible minimum requirement: Coding as national/international (inside/outside the relevant MS). This is necessary, if data from the one-day survey are applied as basis for the national medium-/long-distance journeys.

Recommendation for ease of response: Provide the home address and “other, please specify” as options. A majority of diaries begin at the home address, but provision for other places is very important, especially if the data are used for the medium- and long-distance indicators.

Recommendation for ease of response: Coding as actual address in text. This is used to refer the same place later in the interview (this address generally has multiple visits).

Recommendation for quality considerations: Coordinates or similarly detailed information, which is applicable for distance calculations in the questionnaire. This recommendation is elaborated in the section on destination coding and distance verification.

Initial question: purpose at the beginning of the day (destination 0)

This question needs a cautious formulation, as certain activities may be problematic to ask for. One solution is to ask the question only when destination 0 is different from the home address.

Recommended for national applications: Completes the purpose coding, such that every trip has an origin and destination purpose. Then, every trip can be analysed by the combination of the purposes, not only the destination. This is of course of particular interest, when the diary begins at another place than the home.

Possible minimum requirement: If the one-day diary data are used for calculation of medium- and long-

distance mobility, this value is the purpose for overnight journeys.

Response options should be the categories from Section 2.2 (Travel purpose), including the Home option. It is possible to add more options for national reasons, if only these extra purpose options can be grouped as the values in Section 2.2.

Trip N question: address/destination at destination N

"When you left [previous destination], where did you go?" – Refer to Section 2.2 for notes on which destinations are included.

Minimum requirement: Coding at FUA/non-FUA level. This is needed to calculate the urban indicators, as part of the criteria that both origin and destination should be within the urban area, in order for the trip to be regarded as "urban".

Possible minimum requirement: Coding as national/international (inside/outside the relevant MS). This is necessary if data from the one-day survey are applied as basis for the national medium-/long-distance journeys.

Recommendation for ease of response: Provide the home address and "other, please specify" as options.

Recommendation for ease of response: Coding as actual address in text which is then used to refer the same place later in the interview (in case the address has multiple visits).

Recommendation for quality considerations: Coordinates or similarly detailed information, which is applicable for distance calculations in the questionnaire. Please refer to the section on destination coding and distance verification for further elaboration.

Recommended for national applications: Details on the actual trip geography may be used for analysis of national trip patterns. For instance, for transport models, the survey can provide a set of observed trip matrices.

Trip N option: No (more) trips

"When you left [previous destination], where did you go?" is presented with an option "I did not leave [previous destination] until the next day".

Minimum requirement: Number of trip registered should be limited, to reduce the burden..

Trip 0 question: Reason for no trips

Respondents finalising the questionnaire without any trips (=at trip 0) should be asked "why?". Answer categories could be for instance "Weather conditions", "Illness", "Disabled" and "Other, please specify". The exact phrasing and other details are left as a decision for the MSs.

Recommended for quality considerations: Experience shows a need for a check-up on this group, which otherwise can reach a very large extent.

Recommended for national applications: With this question it is possible to analyse the structure of the "non-trip" group, especially the difference between immobile people (disabled etc.) and mobile people without trips on the reporting day.

In order to obtain a more meaningful reason than "no need to move", two reasons could be asked (incapacity, weather, activity at home, no car or any driver available, etc.)

Trip N question: purpose at destination N

"Purpose at this destination" – Refer to Section 2.2 for notes on which destinations are included.

Minimum requirement: Travel purpose coding for this trip, regarding urban/short-distance indicators 3c, 3d, 4c, 5d (destination "Home" converts as origin purpose in the post processing).

Response options should be the categories from Section 2.2 (Travel purpose), including the Home option. It is possible to add more options for national reasons, if only these extra purpose options can be grouped as the values in Section 2.2.

The destination purpose is one of the most important questions of the entire survey. This variable is necessary for many of the mobility indicators and is likely to be of great importance for national applications of the data.

Trip N question: departure time

"When did you leave [destination N-1] for [destination N]?"

Recommended for quality considerations: Time information is needed to check for time-duration consistency between trips.

Recommended for quality considerations and ease of response: The respondent will most probably need the time as reference in the questionnaire. Otherwise, the interview might "get lost" and continue by a random trip

Recommended for national applications: Analysis of transport patterns dependent on time of the day, which usually is related to congestion.

Trip N question block: modes, driver/passenger, distances, travel times, waiting times

"How did you get from [destination N-1] to [destination N]? Please state each mode individually."

Minimum requirement: This is the most important part of the questionnaire, with regard to the Harmonized Mobility Indicators – as well as other applications of the data.

It is recommended to ask this as a matrix with the stages – this could for example look like as follows:

	Waiting time	Travel mode	Driver or passenger	Distance	Travel time
1	xxx min	(choice of modes)	(choice driver/pass)	xxx km	xxx min
2	xxx min	(choice of modes)	(choice driver/pass)	xxx km	xxx min
3	xxx min	(choice of modes)	(choice driver/pass)	xxx km	xxx min
…					
SUM	XXX min			XXX km	XXX min

The **waiting time** is recommended for quality considerations. When waiting is reported separately, travel speed checking can be done with a greater precision. If the waiting time is excluded from the questionnaire, the time spend waiting should be included in the travel time.

The **travel mode** is a minimum requirement, in conformity with list of modes mentioned in Section 2.2.

Driver/passenger is a minimum requirement for modes "car" and "taxi". This distinction is necessary for calculation of figures as driver/passenger (urban/short-distance indicators 2b, 3b, 3c, 4b, 5b, 5c) and reporting of vehicle occupancy (urban/short-distance indicator 6). Driver/passenger is recommended for the remaining motorized modes, because of possible national applications.

Stage distance is a minimum requirement (urban/short-distance indicators 3, 5 and 6).

Stage travel time is a minimum requirement (urban/short-distance indicators 4).

Recommendation for quality considerations and ease of response: Provide the respondent with a total sum for all modes and estimated arrival time at the destination.

Recommendation for quality consideration: Checking that average travel speed (distance/time) for each stage is within reasonable limits.

Recommendation for quality consideration: Checking that the total reported distance is consistent with the physical distance between destinations [N-1] and [N]. Please refer to the section on destination coding and distance verification for its elaboration.

Trip N question: car usage

For passenger car trips, “Which car did you use?” - For non-household cars: “Which fuel type?”

Minimum requirement for trips with mode car: Required for statistics by fuel type (urban/short-distance indicators 3c, 5c).

Response options should be the household cars from the background section plus option “non-household car”. For “non-household car”, direct questioning on the fuel type, cf. Section 2.2. Note that the fuel type categories are dependent of national availability and likely to improve over time.

Recommendation for quality considerations and ease of response: Ask for the household car ownership in the intro section, then for each trip car as a driver “Which car?” This is easier for the respondents to comprehend and provides data of higher quality.

Depreciated alternative: Direct question for all passenger car trips, “Which fuel type?”.

Trip N question: accompanying passengers within the survey age span (15-84)

“How many other persons between 15 and 84 were present in the car?” The taxi driver is excluded.

Trip N question: accompanying passengers outside the survey age span (15-84)

“How many persons, younger than 15 or older than 84, were present in the car?”

Minimum requirement for trips with mode “car” or “taxi”: Required for calculation of car and taxi occupancies (urban/short-distance indicator 6).

Recommendation for quality considerations and ease of response: Splitting the “outside” category in two: younger than 15 and older than 84.

Recommendation for national applications: Reporting for a larger subset or even all modes. This extension supports analysis of group travel, cost sharing and generally how co-travellers affect the travel patterns.

Possible national extension: More detailed reporting: More age groups, or even selecting the individual household members on the trip, plus fields for reporting passengers from outside the household. This extension provides further possibilities for analysis on co-travelling patterns.

If these questions are extended to public transport and/or bicycles, it is important only to count accompanying persons who had the intention to travel with the respondent – inter alia: family members and friends, but not random bus passengers.

If the survey age span is other than the recommended minimum, (15-84 years), the questions on accompanying passengers should be phrased with the relevant age interval.

Special note on professional transport

Trips where the actual mileage is the professional duty of the respondent are excluded from the survey. This does not raise a problem when professional trip starts and ends at the workplace. If that is the case, every stage and stay of the trip s excluded and the time is accounted as stay at the workplace.

However, in certain cases a driver may start his duty at one place and end at another, without the need to report to the workplace. Thus, a small addition to the questionnaire is necessary, such that the respondent can “unlock” the destination/distance verification and report a different origin for the next trip in this special case. There are several solutions to this. The detail is left to the MS, as the decision only affects a very small proportion of the mileage.

6.4 Destination coding and distance verification approach

A key quality factor is the need for verification of the relations between destinations, modes and distances. It has been observed that simple reporting of modes and distances without verification is likely to underreport the total mileage by 30% or more.

The most important reason to this is that respondents tend to underestimate the travel distance. Underreporting of trips is another issue, but the non-reported trips tend to be short non-motorized trips. Thus, underestimation of distances and non-reporting of trips are two separate issues. This section focuses on how to handle the trip distance issue.

The distance verification is a true quality consideration, and mentioned as such in Section 4. However, the conclusion is that some of the verification should be done during the actual interview. This section covers the implications for the questionnaire.

The key component of the distance verification is a detailed coding of each destination, as address, coordinates or small model zones. Then, it is possible to calculate the distance for each trip, between the stated origin and destination[21].

This distance verification may be done by two different concepts:

One concept is to calculate the Euclidean distance ("straight-line distance") between the coordinates. This has the advantage, that given the correct coordinates, this is a strict lower bound to the distance. Any shorter distances are physically impossible and the only issue is how to correct the data. The detour factor is then defined as the stated distance divided by the Euclidean distance. Depending on the quality of the infrastructure, the average detour factor is likely to be in the interval 1.2 to 1.3. There is no theoretical upper limit for the detour factor. It is also possible to use Euclidean distances with approximate coordinates, e.g. zone centroids, with a simple correction to cater for the uncertainty of the location.

The other concept is to base the check on a route-choice model, either from a formal transport model or from one of the shortest route applications available. This has the advantage that the calculated distance is realistic with regard to the transport network and any physical obstacles. In most of these tools, it is possible to calculate either the shortest or the most likely route, which both are handy for the distance verification. The calculated distances can never be better than the transport network behind the calculations. Nobody has a complete dataset on off-road tracks or footpaths. Even the best of these datasets contains errors in the network, or are outdated because of infrastructure improvements. Thus, it is not possible to apply a route-choice model as a strict lower bound, but only as a guide to probable values.

The conclusion is that some kind of distance/destination verification is crucial to the quality, but also that several approaches exists.

One important issue is whether to do the verification interview time, in order to get a more precise information from the respondent, or to do the verification in the post-processing. This is, basically, a trade-off between interview time and quality. The best quality is obtained by doing as much as possible interview time, because the respondent has the right answer. It is important to observe that a "distance error" is likely to be triggered by an error in the destination coding. Destination errors found by the distance verification is a good reason for doing this verification, when the respondent is still available to confirm.

A third solution could be to exclude the distances from the questionnaire and rely entirely on the modelled distances. This approach sounds appealing, but contains some fundamental problems: one problem is that detours are not modelled. This includes trips with same places as origin and destination as well as any case where a "sub-optimal" route is chosen. It is quite common to choose a longer route because of various reasons, which even may be non-transport issues. Another problem is that large deviations between stated and calculated distances are often related to errors in the destination coding; this leads to a bias with too many long distance trips. A third problem is related to trips with unknown destinations.

A special issue is the "unknown destination". This covers cases such as "don't know", "impossible to code" as well as cases where the respondent is unwilling to provide the detail or even discretionary issues like a

[21] This distance calculation is indeed the foundation for the conclusion, that most trip lengths are underestimated. The test is simple: ask a random sample for trip origin and destination details plus the distance, without any checking. Then post-calculate the distance and compare. It is not uncommon to find 30% or more with stated distances shorter than the Euclidean distance.

doctor visiting his patients. Trips with unknown destinations should still be part of the data. Thus, the questionnaire should support cases where one or more destinations are unknown.

Related quality verification is the travel speed for each stage. Every mode has a specific minimum, typical and maximum average travel speed. Thus, for every stage the travel speed as distance divided by time should be within the possible range. Given that departure time + travel time = arrival time, this should be before the departure for the following trip. In the programming of the questionnaire and post-processing tools, this evolves into a series of quality checks on the relations between distances, travel times and modes, which together supports a good overall quality of the data.

In an even more sophisticated approach, it is possible to add questions on border crossings, stations, airports etc. in order to strengthen the distance verification and/or to cater for cases where distances cannot be calculated (data provision may be different in/outside the country or on the sea).

Loop trips are a special case. With the minimum solution of reporting as one single trip, the Euclidean distance is 0, leaving the speed check as the only possible verification. Adding a question on the destination / farthest point provides a solution to this, at the price of extra interview costs. This artificial destination may also be of interest to national modelling applications.

In any case, the destination/distance verification relies on the available auxiliary data. Thus, the decisions on methods for the distance verification is dependent of which data can be made available to the questionnaire and/or the post processing.

6.5 Model questionnaire for the retrospective survey

Prior to any details on the retrospective survey part, it is important to recall the basic reasons for this section.

In theory, it would be perfectly possible to provide data for the medium and long distance mobility indicators based on the one-day interviews. The only requirement is that the survey sample is large enough.

In practice, this approach has two intrinsic problems:

- Especially overnight and international travel influences on the survey response rate. This is due to the fact that it is difficult to get in contact with a respondent who is travelling. As the one-day interview generally regards the day before, there is a correlation between overnight travel activity and response, which works out as an underrepresentation of overnight/international journeys.
- These trips also have a low frequency in the population. Thus, the “large enough” survey may require 500 000 or more interviews.

It is suggested to solve these two problems by a questionnaire on the travel patterns for medium- and long-distance journeys, retrospective for the past 1, 2 or 3 months.

Due to weighting issues, it is recommended to phrase the questions based on the past, completed, calendar months. Then, the data can be regarded as 12 independent surveys, one for each month and weighted accordingly. Further, the optimal solution would be one representative sample per month, with field period from the first day of the following month. This is in direct contradiction to the requirements for the one-day survey (cf. above on the choice of 1 or 2 surveys).

Thus, the basic question structure is “How many journeys with [category description] did you have during MM month?” followed by detailed questions on each of these.

The key issue here is which journey categories to ask for. The naïve solution is to ask the 4 categories from the mobility indicators: medium/long-distance crosstab with/without overnight stay.

Direct questioning on the number of trips within a certain distance band relies on the respondents’ judgement on the journey length. As mentioned in the section on distance verification, respondents tend to underestimate travel distances. This results in a severe[22] underestimation of the medium/long-distance trips. The immediate solution is to ask for every journey longer than 240 km (80% of 300 km). Then the journeys are grouped into

[22] Severe, because each distance band is dominated by the shortest journeys in the interval, which are primarily affected by the distance error.

distance bands in the post processing, and the correct journey count calculated on this foundation.

The categories “one-day”/”overnight” are unproblematic in the questionnaire, as they are easy to remember and comprehend. Asking for overnight journeys has the property that every month can contain no more than 15 overnight journeys, which provides a maximum interview length.

Given a running survey or a good pilot survey, it is possible to evaluate the frequencies of medium/long-distance journeys. With this information, it is possible to assess whether the retrospective part needs to cover one-day and national journeys, or whether this can be drawn from the one-day part. If successful, this test allows a more simple approach with only international overnight journeys in the retrospective section. The indicators are then calculated as the sum of national and international journeys from the respective sources.

The same pilot data are needed for an optimal dimension of the survey with regard to size (number of interviews) and memory horizon (number of months in questionnaire). Without a priori information, it is recommended to ask for the last 3 months. Then 10 000 interviews will cover the equivalent of 900 000 one-day interviews.

Again, without a priori information on journey frequencies, it is recommended to ask for any international or overnight journeys with a distance longer than 240 km. National one-day journeys are likely to be sufficiently covered by the one-day interview, regardless of distance.

Question: How many journeys with [category description] did you have during MM month?

As for the one-day questionnaire, professional transport journeys are excluded. Any journeys where the actual mileage is the respondent’s professional business are excluded.

Minimum requirement: Key parameter for calculation of the totals, as well as for the function of the questionnaire.

The questionnaire may be formulated with one or more categories, following the considerations above. This detail is left as decision for the MS, as the optimal solution depends on the survey size and the frequency of long-distance journeys.

The following questions are asked for each of the reported journeys. If the retrospective questionnaire covers medium-distance national journeys, it may be necessary to apply a limit on the total number, to avoid an excessive interview duration. In this case, it is important to take measures to ensure the journeys with detailed information are a representative sample of the total.

The actual questions for each journey are a simplified subset of the trip questions in the one-day questionnaire.

Journey N question: address/destination

“Please state the primary destination of this journey” / first/last overnight stay.

Possible minimum requirement: Coding as national/international (inside/outside the relevant MS). This is necessary, if data from the one-day survey are applied as basis for the national medium/long-distance journeys.

Recommended for quality considerations: Coordinates or similarly detailed information. Distance verification.

Please refer to the section on destination coding and distance verification for elaboration on this recommendation.

Journey N question: departure date

"When did you leave for …"

Recommended for quality considerations and national applications: Cross-checking that the reported journeys are consistent. National applications on more precise distributions of the journeys.

Journey N question: arrival date

"When did you return home from …"

Recommended for quality considerations and national applications: Cross-checking that the reported journeys are consistent. National applications on more precise distributions of the journeys.

Journey N question: purpose

Minimum requirement: Two options: "Professional/business" or "personal/leisure". Travel purpose coding for this journey, regarding medium/long-distance indicators 2c, 3d, 5d.

Recommendation for quality considerations and national applications: More detailed purpose coding, as in the one-day diary. Application of the same purpose categories supports national applications comparing short- and long-distance trips.

Journey N question block: modes, driver/passenger, distances

"How did you get to the primary destination? Please state each mode individually."

For the medium/long-distance mobility, it is not necessary to include short bicycle/walking stages, shorter than 1 km.

Minimum requirement: This is the most important part of the questionnaire, with regard to the Harmonized Mobility Indicators – as well as other applications of the data.

It is recommended to ask this as a matrix with the stages – this could for example look as follows:

	Travel mode	Driver or passenger	Distance
1	(choice of modes)	(choice driver/pass)	xxx km
2	(choice of modes)	(choice driver/pass)	xxx km
3	(choice of modes)	(choice driver/pass)	xxx km
…			
SUM			XXX km

The **travel mode** is a minimum requirement, cf. the mode list mentioned in Section 2.2 (medium/long-distance part).

Recommendation for quality consideration: Driver/passenger for passenger car stages. This distinction is necessary for the reporting of vehicle occupancy (medium/long-distance indicator 6). The driver/passenger question may be asked for the remaining motorized modes, because of possible national applications.

Stage distance is a minimum requirement (medium/long-distance indicators 3 and 5)

Recommendation for quality considerations and ease of response: Provide the respondent with a total sum for all modes.

Recommendation for quality consideration: Checking that the total reported distance is consistent with the physical distance to the destination. Please refer to the section on destination coding and distance verification for its elaboration.

For medium/long-distance journeys, the distance for airplane stages is of particular interest, because the actual distance is most likely unknown by the respondent. One solution is to add a question "which airport" before and after each airplane stage. The distances may then be calculated in the post processing, or interview time, given coordinates for each airport.

Journey N question: car usage

For passenger car trips, “Which car did you use?” - For non-household cars: “Which fuel type?”

Minimum requirement for trips with mode “car”: Required for statistics by fuel type (medium/long-distance indicator 3c, 5c).

Response options should be the household cars from the background section plus the option “non-household car”. For “non-household car”, direct questioning on the fuel type, cf. Section 2.2. It is recalled that the fuel type categories are dependent of national availability and likely to improve over time.

Recommendation for quality considerations and ease of response: Ask for the household car ownership in the intro section, then for each journey with car as a driver “Which car?” This is easier for the respondents to comprehend and provides data of higher quality.

Depreciated alternative: Direct question for all passenger car trips, “Which fuel type?”

Trip N question: accompanying passengers within the survey age span (15-84)

“How many other persons between 15 and 84 were present in the car?”

Trip N question: accompanying passengers outside the survey age span (15-84)

“How many persons younger than 15 or older than 84 were present in the car?”

Minimum requirement for trips with mode “car”: Required for calculation of car occupancies (medium/long-distance indicator 6).

Recommendation for quality considerations and ease of response: Splitting the “outside” category in two: younger than 15 and older than 84.

Recommendation for national applications: Reporting for a larger subset or even all modes. This extension supports analysis of group travel, cost sharing and generally how co-travellers affect the travel patterns.

Possible national extension: More detailed reporting: more age groups, or even selecting the individual household members on the journey, plus fields for reporting passengers from outside the household. This extension provides further possibilities for analysis on co-travelling patterns.

If these questions are extended to public transport, it is important only to count accompanying persons, who had the intention to travel with the respondent – inter alia, family members and friends, but not random bus passengers.

If the survey age span is other than the recommended minimum 15-84 years, the questions on accompanying passengers should be phrased with the relevant age interval.

6.6 Big Data to understand travel behaviour

Various technologies aiming at collecting data on travel behaviour have emerged in recent years (ITF, 2015 and Shanti, 2012). These technologies generate a massive and continuous amount of data. An example is for instance the location data from mobile phones stored on a continuous basis for billing purposes by network operators.

New technologies to capture geo-localized data

A large number of technologies are capable of providing data that may be relevant for observing travel behaviour. Among these, the following may be mentioned:

- GNSS (Global Navigation Satellite Systems). The most known systems are GPS, GLONASS, GALILEO and BEIDU;
- Mobile Communication Positioning (cellular telephony);
- Smart card data.

GNSS positioning: the most widely used GNSS system is the GPS (Global Positioning System). The GPS is a satellite-based radionavigation technology. Satellites provides geolocation and time to any GPS receiver. The GPS does not require the user to provide any information. A pure and assisted GPS (A-GPS) can be distinguished:

- A pure GPS positioning can be obtained with a GPS receiver box. The receiver needs to capture the signals of at least four satellites equipped with clocks to provide geolocation and time information.
- An assisted GPS positioning can be obtained with a smartphone application. In addition to a pure GPS positioning signal, accelerometer data, WIFI data and mobile data connections may be gathered.

Mobile Communication Positioning: The localisation of a mobile phone can be obtained in two ways: actively and passively.

- Passive positioning: The positioning of the handset is derived from log-files created by mobile network operators (MNO). The log-files contain all activities of the handsets in the network, i.e. of calls, text-messaging and data transfer activities, and these logs include data on the antennas to which the handsets were connected and the time the activities occurred.
- Active positioning: A network operator can make a probe inquiry in the network to establish the location of a specific handset, i.e. “ping” the handset, so that the handset replies to the network, and thus reveals which antenna is used for a connection, and thus in which area it is located.

In 2019, 71% of the population of the 27 EU countries had a smartphone that can access internet[23]. If all of these smartphones’ GPS data could be collected, the potential data collection would reach more than 300 million individuals.

Public transport can provide smart card data with the boarding logs for all cards, which generates large-scale data.

[23] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_ci_im_i&lang=en

Geographic resolution by type of technology
In terms of geographic resolution, smart cards have the best resolution (provided that geocoded reader locations are available) but these data provide only information on public transport mobility.
The GPS has a geographic resolution within a range of a few meters. For mobile phone positioning the geographic resolution depends on the area, from some meters in urban zones to hundreds of meters in rural areas.

Add-on information by type of technology
With passive mobile phone positioning data, it is not possible to obtain additional information. But using active mobile phone and GPS positioning may allow to add information that it is not collected automatically (such as household size, income range, etc.).

Volume of the data
The sample size with mobile phone tracking may potentially be very substantial: thousands or even millions of individuals may be tracked in this way. Furthermore, the tracking time may also be broader compared to GPS tracking. While some studies using GPS data reach tracking durations of a couple of months, mobile phone tracking may potentially last for years, since it is only limited by the duration the log files are kept by network operators or eventually by the duration the respondents keep their telephone network contracts.

Gain in measurement errors
The GPS chip records spatial and time coordinates without any necessary action of the user. In particular, this means the GPS applications catch all trips that the respondents undertake, provided the device is always carried by the respondent. In particular, this avoids omissions that respondents may make during a questionnaire or an interview. The GPS applications also have the advantage of giving very reliable and accurate trip distance and time. In traditional mobility surveys, respondents may not know the travel distance and the travel duration and those data are often rounded.

How can GPS data be used for distance calculation?
Usually, the GPS technology offers a set of position points with two spatial coordinates (latitude and longitude) and a time coordinate (date and hour of the day). These coordinates between two points can be used to calculate distance and time of moving.
Because GPS data usually collects position points that are very close together, it is recommended to use the Haversine formula for the calculation of the distance between two points. Given one point $A_1(\phi_1 ; \lambda_1)$ and one point $A_2(\phi_2 ; \lambda_2)$, with ϕ representing the latitude (in radians), and λ representing the longitude (in radians), the distance d "as the crow flies" (in kilometers) between A_1 and A_2 is :

$$d = 2r \arcsin\left(\sqrt{\sin^2\left(\frac{\phi_2 - \phi_1}{2}\right) + \cos(\phi_1)\cos(\phi_2)\sin^2\left(\frac{\lambda_2 - \lambda_1}{2}\right)}\right)$$

with $r = 6371$ km being the approximate radius of the Earth.

Interpretation of GPS logs
As GPS records spatial and time coordinates, these logs need to be interpreted in term of trips (origin and destination), trip purpose and stages mode.
Without any other information, each of the trips have to be deduced by machine learning algorithms, based on speed calculation (duration at the same place). Once these trips have been determined, the respective mode and purpose have to be imputed by algorithm as well. Doing this will produce false positive values, much more than a traditional mobility survey would. It is therefore recommended to collect at least the following in a GPS data survey:

- Trip status
- Trip purpose
- Mode of each stage

In some locations, such as underground mass transit networks, the GPS chip fails to capture information; but it is easy to recognize such trips and implement the relevant details.

GPS Survey duration

With surveys on mobility using interviews, only a one-day travel diary is measured (otherwise the respondents' burden would be too heavy) while a survey using a GPS application can for instance observe a multiday travel diary (full week).

Representativeness of the sample

Using Big Data, some issues should always be considered:

- The distribution of smartphones (and its use) does not cover the entire population, in particular the elderly and the lowest income classes;
- Even if a person has a smartphone, it is not certain if this person accepts to download an application that may consume a lot of battery power and measure spatial and time coordinates (privacy issues);
- Customer profiles may differ depending on the mobile network operators. In addition, these operators have different processes for interpreting logs, which makes comparisons difficult, especially between countries.

Annex 1: Questions asked

Question

"I would appreciate your clarification on the calculation of indicators in Table 2 "per person/per day". We have different breakdowns there and I became familiar with the description at 2.5.1.; but still have a question:

For instance, if we need to calculate the number of trips per person/per day of passenger car drivers, we take all weighed number of trips of passenger car drivers and divide by weighted number of:

- respondents who were passenger car drivers or
- respondents who were trip makers or
- all respondents in the survey (trip makers and non trip makers)

Please confirm which part of the population we need to take for the calculation of Eurostat indicators."

Experts' response

For the calculation of the number of trips per person/per day of passenger car drivers, we take all weighted number of trips of passenger car drivers and divide by the weighted number of "reference population" (trip makers and no-trip makers).

The SHANTI project has shown that dividing by the number of only respondents who were trip makers, we obtain an indicator which is more directly comparable across countries, because the proportion of trip makers depends a lot upon survey methodology. However, the exclusion of no-trip makers from the denominator can be implemented *a posteriori*.

The definition of travel distance per person per day: Weighted travel distance in kilometres divided by weighted number of respondents on the actual day.

Calculation of weighted travel distance per person per day: The weighted kilometres per person per day are calculated by summing all respondents' kilometres multiplied by the "weight" of the respondent and divided by the weighted sum of respondents. This is done for all respondents and separately for respondents answering at working days, respective non-working days. For a multi-day survey these results have to be divided by the number of days surveyed (for a 7-day survey the numbers are divided by 7). In case of a shorter survey period than a year, the passenger-kilometres have to be up-weighted to a year.

The definition of "Number of trips per person per day": Weighted number of trips divided by the weighted number of respondents on the actual day.

Trips per person per day are calculated similar to the distance, by replacing kilometres by 1 (for one trip).

Question

"Could you please help us with the calculation of indicator "number of trips per person/per day" because it is not entirely clear according to the definitions in the guidelines which number of respondents should be used for the calculation of indicators.

Just below is a simplified table with data and we would be very grateful if you could send us an explanation for the calculation of indicators for all days, working days and non-working days as well as total mobility and urban mobility, for total, by mode of transport and by travel purpose. In this table:

1) one respondent replies for only one day

2) for „non-working day" respondent replies for only one non-working day, for a Saturday or for a Sunday

3) available information for respondents with no trips are added to the table in attachment.

We would like to have as accurate calculation as possible. We hope that our inquiry is no problem for you."

ID PERSON	Type of day	Urban Mobility	Travel Mode	Travel Distance	Travel Duration	Purpose	Number of Trips
1	working	yes	passenger car as driver	10	15	work	1
1	working	yes	taxi	15	20	leisure	1
2	non-working	yes	bus	20	30	professional	1
2	non-working	no	bus	5	10	education	1
2	non-working	no	train	25	20	shopping	1
3	non-working	no	passenger car as passenger	40	45	leisure	1
3	non-working	no	cycling	7	30	work	1
3	non-working	no	walking	1	15	shopping	1
4	working	yes	waterways	25	50	leisure	1
5	working	yes	bus	25	30	education	1
5	working	yes	train	70	70	work	1
6	working	yes	bus	15	20	work	1
6	working	no	train	75	50	professional	1
7	working	no	taxi	6	10	education	1
7	working	no	bus	18	30	shopping	1
8	non-working	yes	passenger car as driver	20	35	escorting	1
8	non-working	yes	cycling	3	10	leisure	1
9	non-working	yes	passenger car as passenger	4	5	leisure	1
9	non-working	yes	train	26	20	work	1
10	non-working	yes	taxi	3	10	personal business	1
11	working	yes	bus	14	25	work	1
12	working	no	passenger car as passenger	15	25	shopping	1
13	working	no	passenger car as driver	20	30	leisure	1
14	non-working	no	bus	17	20	professional	1
14	non-working	no	taxi	6	15	shopping	1
15	non-working	yes	train	44	50	personal business	1
15	non-working	yes	passenger car as driver	40	30	education	1
16	working	yes	bus	20	20	work	1
17	non-working	yes	train	25	15	professional	1
18	working	yes	taxi	5	10	shopping	1
19	non-working	yes	passenger car as passenger	7	13	work	1
20	non-working	yes	train	60	75	personal business	1
20	non-working	yes	passenger car as driver	20	35	shopping	1
21	working	no	cycling	3	15	leisure	1
21	working	no	passenger car as passenger	15	20	work	1
22	non-working	no	walking	2	30	escorting	1
23	non-working	no	taxi	4	5	work	1
24	non-working	yes	bus	7	17	work	1
25	non-working	yes	walking	2	25	leisure	1
26	non-working	yes	passenger car as driver	5	10	work	1
26	non-working	yes	bus	15	25	personal business	1
27	working	no	passenger car as driver	9	15	personal business	1
27	working	no	walking	2	20	leisure	1
28	non-working	no	walking	1	12	escorting	1
28	non-working	no	bus	5	7	personal business	1
29	non-working	yes	passenger car as driver	7	9	work	1
30	non-working	yes	passenger car as passenger	8	10	personal business	1
31	working						0
32	non-working						0

Experts' response

Here below are the results of the calculation of indicators

	Working day		Non-Working day		All days	
	Urban mobility <100 km	Total mobility <300 km	Urban mobility <100 km	Total mobility <300 km	Urban mobility <100 km	Total mobility <300 km
TOTAL number of trips per person/per day						
a) Total	11	20	16	27	12.43	22.00
b) By main travel mode						
by passenger car (total)	2	6	7	8	3.43	6.57
as driver	2	4	4	4	2.57	4.00
as passenger	0	2	3	4	0.86	2.57
by taxi (as passenger)	2	3	1	3	1.71	3.00
by van/lorry/tractor/camper	0				-	-
by motorcycle and moped	0				-	-
by bus and coach	5	6	2	5	4.14	5.71
by train	1	2	4	5	1.86	2.86
aviation	0				-	-
waterways	1	1			0.71	0.71
cycling	0	1	1	2	0.29	1.29
walking	0	1	1	4	0.29	1.86
other	0				-	-
c) By travel purpose						
work	5	6	5	7	5.00	6.29
professional		1	2	3	0.57	1.57
education	1	2	1	2	1.00	2.00
shopping	1	3	1	4	1.00	3.29
escorting			1	3	0.29	0.86
leisure	2	5	3	4	2.29	4.71
Personal business		1	5	6	1.43	2.43

	Working day		Non-working day		All days	
	Urban mobility <100 km	Total mobility <300 km	Urban mobility <100 km	Total mobility <300 km	Urban mobility <100 km	Total mobility <300 km
2) Number of trips per person/per day						
a) Total	0.69	1.38	0.95	1.53	0.77	1.43
b) By main travel mode						
by passenger car (total)	0.08	0.38	0.42	0.47	0.18	0.41
as driver	0.08	0.23	0.26	0.26	0.13	0.24
as passenger		0.15	0.16	0.21	0.05	0.17
by taxi (as passenger)	0.15	0.23	0.05	0.16	0.12	0.21
by van/lorry/tractor/camper	0.31	0.38	0.16	0.32	0.26	0.36
by motorcycle and moped	0.08	0.15	0.21	0.26	0.12	0.19
by bus and coach		0.08	0.05	0.11	0.02	0.09

by train	0.08	0.08			0.05	0.05
aviation		0.08	0.05	0.21	0.02	0.12
waterways	0.69	1.38	0.95	1.53	0.77	1.43
cycling						
walking	0.08	0.38	0.42	0.47	0.18	0.41
other	-	-	-	-	-	-
c) By travel purpose						
work	0.38	0.46	0.26	0.37	0.35	0.43
professional		0.08	0.11	0.16	0.03	0.10
education	0.08	0.15	0.05	0.11	0.07	0.14
shopping	0.08	0.23	0.05	0.21	0.07	0.22
escorting			0.05	0.16	0.02	0.05
leisure	0.15	0.38	0.16	0.21	0.16	0.33
Personal business		0.08	0.26	0.32	0.08	0.15

For the sake of clarity, we chose to show the formulas that should be applied. These appear in the dedicated document attached (to calculate the total for "Number of trips per person/per day for Urban mobility".

Please note that some subscripts on the sums need to be modified to calculate other indicators; e.g. for "urban mobility >100 km", one has to take "u=Urban mobility>100 km" in the sum. If one only wants to consider the mobility by passenger cars, one has to take in the sum "m=car as driver & car as passenger", etc.

Where:

$w_{i,d}$: The weight of the individual i that replies for the day d (d could be one of the following day: Monday or Tuesday or …. Friday or Saturday or Sunday)

i is the i[th] individual that belong to the respondent sample

d: day (Monday or Tuesday or …. Friday or Saturday or Sunday (bank holiday should be considered as a Sunday))

$t_{i,u,d,m,p}$: Number of trips made by the individual i that living in localisation u, on the day d, with mode m and for the purpose p

u: type of localization (Urban mobility or Total mobility)

m: mode (car as driver; car as passenger; taxi (as passenger); van/lorry/tractor/camper; motorcycle and moped; bus and coach; train; aviation; waterways; cycling; walking; other)

p: purpose (work; professional/business; education; shopping; escorting; leisure; personal business)

Remark: $t_{i,d,m,p,u}$ is equal to 0; 1; 2 … (e.g. 1: if the individual i makes one trip on the day d with mode m and for the purpose p)

For: Number of trips per person/day (working day and Urban mobility <100Km): $M_{\substack{d=Monday\ to\ Friday \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=Monday\ to\ Friday \\ u=\text{Urban mobility}}} = \frac{\sum_{\substack{i\in r \\ d=Monday\ to\ Friday}} \sum_{\substack{i\in r \\ d=Monday\ to\ Friday \\ u=\text{Urban mobility} \\ m=all \\ p=all}} w_{i,d} * t_{i,u,d,m,p}}{\sum_{\substack{i\in r \\ d=Monday\ to\ Friday}} w_{i,d}}$$

For: Number of trips per person/day (Saturday and Urban mobility <100Km): $M_{\substack{d=Saturday \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=Saturday \\ u=\text{Urban mobility}}} = \frac{\sum_{\substack{i \in r \\ d=Saturday}} \sum_{\substack{i \in r \\ d=Saturday \\ u=\text{Urban mobility} \\ m=all \\ p=all}} w_{i,d} * t_{i,u,d,m,p}}{\sum_{\substack{i \in r \\ d=Saturday}} w_{i,d}}$$

For : Number of trips per person/day (Sunday and Urban mobility <100Km): $M_{\substack{d=Sunday \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=Sunday \\ u=\text{Urban mobility}}} = \frac{\sum_{\substack{i \in r \\ d=Saturday}} \sum_{\substack{i \in r \\ d=Sunday \\ u=\text{Urban mobility} \\ m=all \\ p=all}} w_{i,d} * t_{i,u,d,m,p}}{\sum_{\substack{i \in r \\ d=Sunday}} w_{i,d}}$$

For: Number of trips per person/day (Non-working day and Urban mobility <100Km): $M_{\substack{d=\text{Non-working day} \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=\text{Non-working day} \\ u=\text{Urban mobility}}} = \frac{1}{(number\ of\ non-working\ day)} \left(M_{\substack{d=satday \\ u=\text{Urban mobility}}} + M_{\substack{d=Sunday \\ u=\text{Urban mobility}}} \right)$$

Note: that the number of non-working days is generally 2 (unless there is a bank holiday).

For: Number of trips per person/day (all day and Urban mobility <100Km): $M_{\substack{d=\text{all day} \\ u=\text{Urban mobility}}}$

$$M_{\substack{d=all\ \text{day} \\ u=\text{Urban mobility}}} = \frac{1}{365} \left(number\ of\ working\ day * M_{\substack{d=Monday\ to\ Friday \\ u=\text{Urban mobility}}} + number\ of\ saturday * M_{\substack{d=satday \\ u=\text{Urban mobility}}} + number\ of\ sunday * M_{\substack{d=Sunday \\ u=\text{Urban mobility}}} \right)$$

Question

"Our survey period was in September and October 2017 – 6 weeks. The selected persons were supposed to give data for one day. Days in the weeks were more or less equally distributed.
Here we have 2 questions:
- The share of trip-makers: we understand that this is a non-weighted data.
- The number of trips: non-weighted data
We are asking for clarification, how to calculate a number of passenger km for all reference population per year. We have a number of km made by 8842 persons (net-sample) in 6 weeks. If we multiply the number by weights we get the number of km for approximately 1.7 million persons (reference population=trip and non-trip makers).
To calculate an annual number of km (PKM) we should add number for another 46 weeks. Or calculate the distances per person per day and multiply by 365?
Please, if you have any other instruction or recommendation, we will be grateful – we will be able to calculate in a right way."

Experts' response

The "share of trip makers" and "number of trips" asked in Table 2 need to be weighted (then we can calculate with the Excel sheet the mobility of mobile persons [no need to compute the full survey]).

For "number of passenger km for all reference population per year" that needs to be broken down by: (Working Day / Non-working Day / All Days) x (Urban mobility / Total mobility)

Passenger-km should be:

Passenger-km (of working days) * number of working days in the year + passenger-km (of non-working days) * number of non-working days in the year

or:

(passenger-km (of working days) * 5 + passenger-km (of non-working days) * 2) * 52.

However, by doing this we pretend that the year is composed with 5*52 + 2*52 = 364 days (instead of 365 or 366 days).

These figures can be retrieved from Table 2 part 3 (page 29 of the 2016-edition of the Guidelines – Travel distance per person/day (km)):

"number of passenger km for all reference population per year" = Travel distance per person/day (km) * population * number of days

It is assumed that you collected data during a six-week period. It would be better to collect the data over a full year.

Question

"Calculation of 'average distance per trip': We summarise all respondents' kilometers multiplied by the "weight" of the respondent and then we should divide the number by the weighted sum of trips of all respondents multiplied by the weight of respondent. I did not find the indicator in the chapter 2.5.2."

Experts' response

The "average distance per trip'' should be calculated as the weighted sum of all distances divided by the weighted sum of the total number of trips. There is no need to divide by the weighted sum of the respondents. However, the average distance per trip is not recommended in the set of indicators.

Question

„According to our preliminary calculation of number of trips per person per day using formula for all day, we found that number of trips is lower than 1. As we explained, each respondent was surveyed only for one day (one working day OR one non-working day). Is the formula that you provided suitable in our case?"

Experts' response

Although theoretically possible, less than 1 trip per day is indeed very low.

With only one day surveyed, the formula in the report should work.

Question

"How to group transport vehicles categories for "Taxi"
As a separated item as in the guidelines, or include it in the passenger car as passenger, as in the Technical specifications of the grant (annex 1)?"

Experts' response

Taxi is specified as a separate item in the guidelines. Including "Taxi" in the "passenger car as passenger" would compromise the calculation of the occupancy rate.

Question

"How to consider of country-specific leisure activities?
- inclusion of mushroom picking, berry picking and hunting as a reason for making a trip in the survey. These leisure activity results in the survey have a hardly estimable distance (walk in the forest) and with a relatively long duration of 3–5 hours. If we calculate the average speed, it is close to zero; moreover, the trips are atypical. If want to compare the data on average distance walked with other countries, these could differ because of these country-specific activities."

Experts' response

The existing breakdown by travel purpose reflects possible intentions of people why the trips are made. It would not be reasonable to distinguish one separate way to spend free time (recreation) from the other leisure activities. Moreover, mushroom and berry picking may be done as both work and recreation. In addition, the statistics acquired will be seasonal. Similar situation may be observed in respect to cycling. Cycling in different races at amateur level or daily routines are quite popular in Latvia. The number of kilometres travelled in such activities is high, but it should not be included in the distance travelled by bicycle, as the main purpose of it is recreation. Such cases will be seen also in the situations when leisure is related to use of transport.

Question

"How to include country-specific leisure activities, such as walks with a stroller, escorting children to playgrounds?. These trips may be considered as personal or leisure but typically have a long duration (several hours) with not so significant distance walked, resulting in an average speed close to zero."

Experts' response

This is a very specific type of trip that does not need to be distinguished separately. It would be difficult to distinguish whether looking after a child at the playground is an integral part of trip or is it a travel purpose. In

general, walking itself is a process and not the purpose to get somewhere. Consequently, walking (also with a stroller) is an activity that should not be included in a mobility survey, since it does not radically differ, for example, from a basketball game that makes players run long distances.

Statistics on walks with a stroller might be useful, for example, for urban planning to plan necessary recreational areas (parks, children playgrounds, etc.). However, in such a case, the data should be detailed at the level of residential areas and even at the level of neighbourhoods (in large cities), since the division into urban and non-urban areas will not provide answers to the questions of these specialists.

Question

"How to consider loop trips in ponds or lakes (mainly fishing trips)?
Typically, respondents cannot report the distance, as they don't know it, whereas the duration of these trips is on average 3–4 hours and respondents tend to report these trips."

Experts' response

Riding a boat is a process itself, and not a purpose to get to a specific destination. If people would not have a purpose to relax, such kind of trip would not be made. It is not necessary to distinguish this type of trip separately.

Question

"On distance: the minimum distance is 100 meters; the registration of trips starts from a minimum distance of 100 m."

Experts' response

From the point of view of the overall assessment of mobility of the country's population, such kind of registration has only disadvantages, as data reliability and quality will likely be low. The general principles of public transport and infrastructure planning do not work with such a detailed breakdown.

Question

"On Distance travelled in kilometers from the respondent's point of view and on the correctness of the distance travelled: after crosschecks of the distances indicated by respondents and a comparison with distances from coordinates, they differed substantially. Is it recommended not to collect distance but impute it from the address coordinates?"

Experts' response

Data summaries of such kind always have a risk of data credibility. The more unusual the trip is, the lower the data credibility. For example, the kilometres travelled during a flight are less likely to be correct, while those travelled to the local store are much more reliable. The solution is to avoid over-detailed breakdown, which allows defining approximate data precisely enough. It is very possible that kilometres calculated by a software after respondent entered starting and end coordinates is even the better solution.

Question

"Distance travelled by public transport: how is it determined (routes, schedules); what are the accuracy requirements?"

Experts' response

In this situation, a system calculating distance based on the starting and destination coordinates may be useful. Planning of public transport routes may use the data characterizing where passengers are moving; thus, such a system should be integrated into the system of public transport routes.

Question

"Trips abroad: is their registration necessary? How detailed should it be? Just the first stop abroad or the entire trip to destination? By stages? For instance, after a flight, public transport is used to reach the final destination. What is the use of this information for national data users?"

Experts' response

A trip abroad helps to characterize habits of the Latvian population, for example, to understand if and why travellers tend to use public transport or a taxi in one place or another. It would allow making conclusions about the processes taking place also in Latvia.
The need for a certain level of detailed elaboration will depend on the person/ institution performing information analysis. In one case, it may be useful to see just the first stop, while in the other – direct and transfer flights may be analyzed. In such circumstances, it is advisable to obtain information about the whole trip by stages.
However, the trips abroad are registered only if the origin is home.

Question

"Mobile population abroad on the reference day: should the respondents who on the reference day were abroad for leisure or work (i.e. mobile) be included in the share of mobile population of the country?"

Experts' response

Yes, they should, but the data for these respondents should be separated. Their trips have a minimal effect when planning public infrastructure. Such information would help to make decisions on the creation of transport infrastructures, such as airports, railway stations, bus terminals, etc.).

Question

"Travel purpose of lunch breaks at work: is their purpose personal business or leisure? Should the respondents receive guidelines or define destinations on their own?"

Experts' response

Lunch breaks are not classic leisure activities but rather a specific part of a day. Moreover, it should be taken into account that this time is spent individually; people may have lunch at a local cafeteria or take food from home. In the latter case, this would not qualify as a trip; while a trip to the nearest cafeteria will take some time. Knowing the options, respondents should be allowed to choose between the personal business and other purpose. Leisure as a travel purpose is mainly associated with an annual leave or holidays.

Question

"Mode of transport – private and public coaches: is it necessary to distinguish between private and public coaches (e.g., in trips made in rural areas to go to work)?"

Experts' response

They should be separated. Commercial activities should also be separated from the individual (private) ones. These activities have different motivations and different goals, which may play a significant role in decision-making.

Question

"Commercial mobility: are courier drivers to be included in trips made for work? When it is assumed that trips are made because of work (construction sites, inspection of objects), how to register respondents on the survey day, such as for instance the trips of taxi drivers made on the reference day?"

Experts' response

Trips made because of work or due to commercial activities shall be researched. Such cases must be registered as trips made to fulfil work duties. This kind of analysis will help in infrastructure planning issues. In particular, trips made by taxi drivers for their work have to be excluded.

Question

"Waiting time: should waiting time be included in the trip time? Should waiting time be included in each of the trip stages?"

Experts' response

For this issue, it is difficult to distinguish forced waiting (airplane, bus) from voluntary waiting. There is a minimum time included in the trip duration, such as for instance waiting for the green light at road crossings. Evaluation of the transport mode requires the analysis of the total time spent to travel from the point "A" to the point "B". It seems appropriate to register waiting time in this breakdown, however we should bear in mind that this time will include both the time spent to wait for the transport means to arrive and the timeliness of the person's arrival (at the stop, station or airport) which remains very individual. In case of doubt the minimum waiting time needed should be included, for example 40 minutes before take-off of a flight or 2–3 minutes at the bus stop.

Question

"Waiting time for non-public transport: should the time spent to wait for a non-public transport be included in the survey?"

Experts' response

The time spent in a traffic jam is included in the trip duration, which gives a logical description of the time spent on a trip. In turn, waiting before or after a drive in a private car is very individual at each occasion. Under ideal conditions, waiting time shall be 0, but in other situations it may be disproportionate due to various personal considerations and circumstances. Therefore, such time should not be included in the survey.

Question

"Waiting time in the airport: two hours by default or the actual? Registration of the time spent when waiting for luggage after the flight. Time spent on transit when waiting for the next plane."

Experts' response

The minimum waiting time should be set at circumstances when there are no significant queues, as the time spent at the airport mainly is a private decision. Luggage reception should not be registered, as a large proportion of passengers fly with hand luggage and do not go through this procedure. The time spent on transit is a forced waiting, which should be included as it is inevitable for reaching the destination.

Question

"Waiting time: when traveling by water, should the time spent waiting for boarding/ embarkation be recorded?"

Experts' response

It shall be registered as a set minimum, just as in the case of air transportation and public transport.

Question

"Accountability of medium and long-distance trips: within the framework of the survey, information should also be acquired on the medium distance (301–1000 km) and long (1001+ km) journeys with overnight stay. Which is the best way to register such kind of trips?"

Experts' response

For smaller countries, medium- and long-distance journeys are large for the country's scale and do not contribute to the planning or solution of various issues.

Question

"How to group transport vehicles categories for vehicles by app – Uber, DriveNow, etc
Shall they have the same classification as taxis? The guidelines mention this possibility, but the item in the questionnaire included both with (Uber) or without (DriveNow) professional driver."

Experts' response

Uber (like a taxi with a personal driver) and *DriveNow* (without a personal driver) are not the same: For *Uber* or similar taxi services: taking into account their current development, it would be interesting to identify these as a separate item.

Either have a separate mode, or have 2 questions:

1) mode: Taxi or *Uber* or similar service
2) if mode ="Taxi or car by app" then ask if it is a Taxi or *Uber* or ....

For *DriveNow* and similar services. It should be in: "Passenger car as driver" or "Passenger car as passenger".

If a country wishes to know the use of *DriveNow* or similar "car sharing" services, then one needs to ask (when describing stages, if it is your "own car", "a rental car", possibly a "leasing car", a "car sharing car" (such as *DriveNow*, *car2go*, etc...).

Question

"How to group transport vehicles categories for Vehicles by app – Mopeds and bicycles
One has to be coherent between these two shared vehicles options, don't you agree? Or is it reasonable to include this in the motorcycle/moped item (being this option enlarged besides the particular vehicle, including shared company)? These shared bicycles have few utilization (the system in Lisbon began some months ago)."

Experts' response

Given the share of bicycles, we suggest to ask two questions:
1) if mode = bicycles
2) then ask: "own bicycles" or "shared bicycles"

Annex 2: Differences and similarities between MSs' data collection practices and collected indicators

Overview of collected information for relevant parameters and variables

This section offers an overview of the information that was available from different data collection actions (NTSs, census, etc.) that were completed in the Member States over the past two decades. Information is presented in the format of tables, with each table presenting information on relevant aspects related to survey methodology and specific parameters that are used to group data (i.e. age, vehicle type, etc.).

Each table is built in a similar way, and information is only presented for those countries where relevant information was reported:

1. **The first section** presents information on particular aspects of the data collection actions. Member States are grouped in five blocks please note that only countries for which such a data collection activity was known and detailed information was available are mentioned. Furthermore, a country can be represented in multiple blocks if different data collection actions are undertaken). Countries are marked with their respective block number :
    - The first block contains countries that have reported a yearly or continuous data collection. This block contains: Bulgaria, Denmark, Estonia, Germany, the Netherlands, Romania, Slovakia, Sweden and the United Kingdom.
    - The second block contains countries that have reported a data collection periodicity of more than one, but less than 5 years. This block contains: Cyprus, Latvia, Norway and Spain.
    - The third block contains countries that have reported a data collection periodicity between five and nine years. This block contains: Finland, Hungary, Switzerland, Turkey and Germany.
    - The fourth block contains countries that have reported a data collection periodicity of 10 years or more. This block contains: Belgium, the Czech Republic, France and Liechtenstein.
    - The fifth block contains countries that have reported no data collection periodicity. This block contains: Austria, Ireland, Portugal and Italy.
2. **The second section** presents information on the most common used method, grouping, a possible overall solution based on the available grouping, a harmonization method proposal and up to three different proposals for grouping.

The following tables are presented:

1. General survey design information :
    - The collection method used and sample size.
    - The survey period and periodicity.
    - The travel diary type used.
    - The survey population.

2. Urban mobility indicators
    - Travel distance information (incl. grouping)
    - Travel time information (incl. grouping)
    - Geographical information (incl. grouping)
    - Travel purposes.
    - Use of different vehicle types and modes

3. Medium distance mobility indicators
    - Travel distance information
    - Travel purposes
    - Use of different vehicle types and modes
    - Travel time

4. General indicators
    - Demographical information collected.

5. Technical traffic indicators
    - Information on the technical aspects of vehicles (technology used).
    - Information on the emissions linked to the vehicles.

Some elements do not pose major problems towards harmonization, a certain number of elements however do. As far as the survey methodology is concerned, this is in particular the case when looking at the time period for which data is collected and periodicity. Up to a lesser extent this may also be the case when non-reported parameters influence the response rate or validity of the chosen sample for the entire population. As far as particular indicators and variables are concerned for which information is collected, and looking at the main objectives (i.e. supporting EU transport policies), this is mostly the case when looking at vehicle types, vehicle technical information, geographical coding and grouping, travel purposes coding and grouping, and respondent age coding and grouping.

PART 1: Urban and short distance mobility

Table 1: General survey design information in relation to the survey period and periodicity

Country	Survey name	Survey frequency	Latest known survey*)	Years covered	Reference period	Day of a week
Bulgaria (I)	National travel survey on passenger traffic buses and coaches	quarterly	Quarterly 2010		Quarter year	
Denmark (I)	National travel survey (TU)	continuous	2016	1992-2003, 2006-	1 day	365 days of the year
Estonia (I)	Use of passenger cars	yearly	April - July 2006		1 day	
Germany (MOP, I)	Deutsches Mobilitätspanel (MOP)	yearly	Annually since 1994	Annually since 1994	7 days	
Netherlands (I)	Dutch travel survey (OViN)	continuous	2010	2010	1 day	Weekday
Romania (TPR, I)	Transport of passengers by road	quarterly	2013	2008-2013	7 days	
Romania (UPT, I)	Urban public transport	yearly	2013	1990-2013	1 quarter	
Slovakia (I)	Annual survey of passenger transport	yearly	2011		1 year	
Slovakia (I)	Annual survey of passenger transport by bus via territory of Slovakia	yearly	2010			
Slovakia (I)	Quarter sampling survey of trips	quarterly	one quarter in 2010			
Sweden (I)	RVU Sverige	continuous	2011-2012	2011-2012	1 day for short distance 30 days for >100km 60 days for >300km	Whole week
United Kingdom (I)	National travel survey (NTS)	continuous	2012	1988-2012	7 days	365 days of the year
Cyprus (II)	Short distance passenger mobility survey	once in 2007, 2008 and 2009	May - July 2009			One working day and a weekend
Latvia (II)	Mobility survey of Latvian population	3 years	September - October 2008		1 day	Specific days of the week
Norway (II)	Norwegian personal travel survey	4 years	2009	2009-2010	1 day	Any day of the week
Spain (II)	Movilia (daily mobility)		October - November 2007	2006	1 day for short distance travel	Any day of the week
Finland (III)	Finish national travel survey	5 years	June 2010 - may 2011	2004-2005	1 day for short distance 2 weeks for >100km car trips	365 days of the year

					4 weeks for >100km other mode trips	
Hungary (III)	Passenger mobility survey	5 years	2009		24 hours	Weekday
Romania (TPC, III)	Transport by passenger cars	5 years	2010	2010	1 working day & 1 weekend day for short distance (<50km) 1 month for long distance (>50km)	Weekday
Switzerland (III)	Microcensus on Travel Behaviour	5 years	2010	2010	1 day	365 days of the year
Turkey (III)	Passenger mobility Survey	5 years	2010		7 days	whole week
Germany (MiD, III)	Mobilitaet in Deutschland (MiD)		2008	2002 & 2008	1 day	365 days of the year
Belgium (IV)	Belgian Daily Mobility (BELDAM)	10 years	December 2009 - November 2010	before 2004	1 day for short travel 1 week for long-distance travel	
Czech Republic (IV)	Population and housing census	10 years	2001		1 day	
France (IV)	French national travel survey	10-15 years	2007 - 2008	2007-2008	1 day for short distance 3 months for long distance	Weekday
Liechtenstein (IV)	Census	10 years	2000	2000	24 hours	
Austria (V)	Mobilitätserhebung österreichischer Haushalte (MÖH)	irregular	September - December 1995	1995	1 day for daily trips 14 days for trips > 50km	Weekday (autumn)
Ireland (V)	National travel survey		2009		24 hours	
Portugal (V)	Portuguese medium and long distance mobility survey	once	May - June 1998		2 months	
Italy (V)	AUDIMOB			2000-2009		Any day of the week
Most common						
Range					1 day - 7 days - 1 month - 1 quarter - 1 year	
Preferred solution		yearly		As up-to-date as possible to avoid under- or overrepresentation of specific	1 day	

				population groups.		
Post harmonisation						
			Harmonisation issues may exist in the sense that comparability is only guaranteed, as far as time is concerned, when overlapping time frames are used as reference periods.		Weighting of days (according to weekday-weekend and holiday-non-holiday)	
EU TRANSPORT policy need recommendation		Optimal solution for EU TRANSPORT policy needs				
Option 1		Yearly data collection	Use of the same reference period for data collection.			weekday, weekend
Option 2						Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday

*) Based on Eurostat previous projects

Table 2: General survey design information in relation to the collection method used and sample size

Member state	collection method	Sampling base	Sample size	Sampling method
Bulgaria (I)	postal	Administrative register of enterprises licensed for passenger transport		Stratified sampling
Denmark (I)	internet telephone	National population register		Stratified random (geographical, age & gender)
Estonia (I)	CAPI	Census	1593 individuals	50% stratified sampling (households by county group) 50% 2-phase sampling
Germany (MOP, I)	Postal, web-based since 2013	Random digital dialling	Appr. 2000 individuals on a yearly basis	Stratified random (household type & car ownership)
Netherlands (I)	CAWI CAPI CATI	Address database	42.100 individuals	Stratified random
Romania (TPR, I)	postal	Business register	999 transport companies	Stratified sampling of business units (economic activity & number of employees)
Romania (UPT, I)	face-to-face		8.300 individuals	Two-stage sampling

Slovakia (PT, I)	postal	List of organisations with more than 20 employees with main activity in transport		
Slovakia (PTB, I)	postal	List of organizations with license of transport by bus		
Slovakia (QS, I)	face-to-face	Census	1.400 individuals	Stratified sampling (gender and region)
Sweden (I)	postal CATI Internet	National population register	41.225 individuals	Stratified random (geographical)
United Kingdom (I)	CAPI	Postcode address file	15.084 addresses (households)	Multistage sampling (1. stratified sampling, 2. systematic sampling)
Cyprus (II)	face-to-face	Census	1056 households, 2410 individuals	Stratified sampling (household density)
Latvia (II)	face-to-face		6.500 households	Stratified random sampling
Norway (II)	telephone	National population register	28.400 individuals	uniform random
Spain (II)	postal PAPI	Municipal population census	49.027 individuals (short distance) 15.355 individuals (long distance)	Stratified random (geographical & household size)
Finland (III)	CATI	National population register		Stratified random (geographical, age & gender)
Hungary (III)	face-to-face	total population	15.000 households	Stratified sampling
Romania (TPC, III)	face-to-face	EMZOT master sampling frame based on 2002 population and housing census	8.728 dwelling	Stratified, multistage and systematic sampling
Switzerland (III)	CATI	Census	62.868 individuals	Stratified random (geographical)
Turkey (III)	CAPI		6.864 dwellings	Two-stage stratified (rural/urban) cluster sampling
Germany (MiD, III)		Communal registration offices		Stratified random (geographical)
Belgium (IV)	postal CATI	National register	7.800 households, 24.000 individuals	Stratified random (geographical & household size)
Czech Republic (IV)	postal	Census		
France (IV)	CAPI	Census + new dwelling	18667 individuals	Stratified random (geographical & car ownership)
Liechtenstein (IV)	postal	Census register	33.300 individuals	
Austria (V)	postal face-to-face	Selected municipalities, Austrian residents, voting registry	12.564 households, 31.912 individuals	Systematic sampling (1. predefined selection of communities, 2. random selection of households
Ireland (V)	CATI	Post geo-directory used to generate sample frame of addresses	7.252 individuals	Multistage sampling
Portugal (V)	CAPI	Frame of addresses		

Italy (V)		Telephone register		Stratified random (geographical, age & gender)
Most common				
Range				stratified random sampling is most often used
Preferred solution				Slight preference for stratified random sampling, but this depends on the sampling base used.

Table 3: Information on the travel diary type used

Member state	Type of questionnaire in daily mobility	Type of questionnaire in long-distance trip	Trip-based/activity-based
Denmark (I)	Telephone or Web		trip-based
Estonia (I)	Trips of a specific predefined day. Telephone interview with memory jogger, a simplified trip diary form sent in advance	Telephone interview with memory jogger, a simplified trip diary form sent before survey	
Germany (I)	Paper and pencil trip diary or web diary for 7 days a week		Activity-based
Netherlands (I)	Diary for a pre-defined day		trip-based
Sweden (I)	Memory collection with memory jogger sent in advance	Data collection with memory jogger	trip-based
United Kingdom (I)	Interview: household, individual and vehicle questionnaires, within 6 days of end of the Travel Week. Diary : 7-day travel diary (each individual in household)	By memory retrospectively + 7-day diary	Stage/trip based
	Trips on a specified day	Collection by memory (diary provided in the advance letter)	trip-based
Norway (II)	Week day before + 1 weekend day by memory	Data collection by memory	trip-based
Spain (II)			trip-based
Finland (III)	Stage diary	Data collection by memory	stage-based
Switzerland (III)	All stages on a specific day	Data collection by memory (with memory joggers)	stage-based
Turkey (II)	Computer Assisted Telephone Interviews based on memory jogger	Computer Assisted Telephone Interviews based on memory jogger	trip-based
Germany (III)	Diary for a pre-defined day	By memory – full description of LAST long-distance trip	activity-based
Belgium (IV)	Trip of the day before. The survey day is predefined	Trips of the day before	
Czech Republic (IV)	Trips of the day before and of the last week end day by memory	3 months by memory + 3 months self-administered with memory jogger.	
France (IV)	Trips of the day before and of the last week end day by memory		trip-based
Post-harmonisation	Optimal form possible of post-harmonisation		
	not relevant	not relevant	Reworking towards trip-based distances.
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs		
Option 1			trip-based
Option 2			stage-based, allowing for merger into trip-based

Tables 4 & 5: Information on the survey population (sample age: lowest age, highest age)

Member state	Lowest age
Netherlands (I), Romania (TPR, I), United Kingdom (I), Cyprus (II), Spain (II), Hungary (III), Turkey (III), Germany (MiD, III), Czech Republic (IV)	no lower limit (UK : <11 years by proxy information)
Estonia (I), Romania (UPT, I), Slovakia (QS, I), Liechtenstein (IV), Portugal (V)	15
Sweden, (I)Finland (III), Switzerland (III), Belgium (IV), France (IV), Austria (V)	6
Denmark (I), Germany (MOP, I)	10
Norway (II)	13
Latvia (III)	5
Italy (V)	14
Ireland (V)	18
Most common	
Range	no lower limit - 18
Most common solution	No lower limit
Post harmonisation	
	Immediate harmonisation may be possible by using the most common denominator in minimum age: 18. However, this does present a more limited dataset.
EU TRANSPORT policy need recommendation	
Option 1	no lower limit
Option 2	15 and over
Option 3	6 and over

Member state	Highest age
Denmark (I), Germany (MOP, I), Netherlands (I), Romania (TPR, I), Romania (UPT, I), Slovakia (QS, I), United Kingdom (I), Cyprus (II), Norway (II), Spain (II), Finland, III), Hungary (III), Latvia (III), Switzerland (III), Turkey (III), Germany (MiD, III), Belgium (IV), Czech Republic (IV), France (IV), Liechtenstein (IV), Austria (V), Ireland (V), Portugal (V)	no upper limit
Sweden (I)	84
Estonia (I)	74
Italy (V)	80
Most common	
Range	74 - no upper limit
Most common solution	No upper limit
Post harmonisation	
	Post harmonisation aimed at the common denominator (74 y.o.)
EU TRANSPORT policy need recommendation	
Option 1	no upper limit
Option 2	80 and over

Tables 6 & 7: Age grouping and collection

Member state	Age grouping
Netherlands (I)	0-12, 12-15, 15-18, 18-20, 20-25, 25-30, 30-40, 40-50, 50-60, 60-65, 65-75, >75
Slovakia (PT, I)	15-24, 25-44, 45-64, >65
United Kingdom (I)	16-18, 19-25, 26-30, 31-40, 41-50, 51-60, 61-70, 71-80, >80
Cyprus (II)	<14, 14-17, 18-25, 26-50, 51-65, >65
Latvia (II)	6-18, 19-24, 25-50, 51-61, >61
Spain (II)	<14, 15-29, 30-39, 40-49, 50-64, >65
Finland (III)	6-17, 18-34, 35-54, 55-64, >65
Hungary (III)	0-14, 15-24, 25-44, 45-64, >65
Belgium (IV)	0-12, 13-18, 19-59, 60-99
Ireland (V)	18-24, 24-34, 35-44, 45-54, 55-64, >65
Italy (V)	14-29, 30-45, 46-64, 65-80
Most common	
Range	High variability (no single fit)

Post harmonisation	
	Preferred method: collection of raw data and reworking towards continuous spectrum.
EU TRANSPORT policy need recommendation	
Option 1	<15, 16-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, >80
Option 2	continuous grouping

Member state	Age collection scale
Denmark (I), Germany (MOP, I), Netherlands (I), Romania (I), Slovakia (PT, I), Sweden (I), United Kingdom (I), Cyprus (II), Latvia (II), Norway (II), Spain (II), Finland (III), Hungary (III), Switzerland (III), Turkey (III), Germany (MiD, III), Belgium (IV), France (IV), Austria (V), Ireland (V), Portugal (V), Italy (V), Lithuania (V)	Continuous scaling
Bulgaria (I), Estonia (I), Slovakia (PTB, I)	Grouping
Most common	
Preferred solution	Continuous scaling
EU TRANSPORT policy need recommendation	
Option 1	Continuous scaling

Tables 8, 9, 10 & 11: Information on travel distance information collected (pkm, vkm, occupancy rate, stage information)

Member state	Passenger km
Bulgaria (I)	yes
Netherlands (I), Sweden (I), United Kingdom (I), Cyprus (II), Finland (III), Hungary (III), Germany (MiD, III), Belgium (IV), France (IV), Italy (V)	yes (can be estimated based on trip length information)
Slovakia (PT, I), Latvia (II), Spain (II), Ireland (V)	no
Most common	
Range	Pkm is mostly collected or can be estimated through trip length information
Solution	Estimate through trip length information
Post-harmonisation	
	Use of pkm, if necessary through estimation of vkm & vehicle occupancy rates
EU TRANSPORT policy need recommendation	
Option 1	Direct collection
Option 2	Estimate through trip length information

Member state	Vehicle km
Germany (MOP, I)	yes
Sweden (I), United Kingdom (I), Hungary (III), Germany (MiD, III), Belgium (IV), France (IV)	yes (can be estimated based on trip length information)
Netherlands (I), Slovakia (PT, I), Cyprus (II), Latvia (II), Spain (II), Finland (III), Ireland (V), Italy (V)	no
Post-harmonisation	
	Estimation of vkm, if necessary through estimation of pkm & vehicle occupancy rates
EU TRANSPORT policy need recommendation	
Option 1	Direct collection
Option 2	Estimation through pkm & vehicle occupancy rates

Member state	Vehicle occupancy rate (passengers)
Denmark (I), Germany (MID, I), Netherlands (I), Romania (I), Slovakia (PT, I), Slovakia (PTB, I), Sweden (I), United Kingdom (I), Spain (II), Finland (III), Switzerland (III), France (IV), Ireland (V), Portugal (V)	yes
Bulgaria (I), Cyprus (II), Latvia (II), Norway (II), Hungary (III), Germany (MOP, III), Austria (V), Lithuania (V)	no
Belgium (IV)	Partially (number of children)
EU TRANSPORT policy need recommendation	
Option 1	Direct collection

Member state	Collection of stage information
Denmark (I), Netherlands (I), Sweden (I), United Kingdom (I), Switzerland (III), Belgium (IV)	Yes
Norway (II), Spain (II), Finland (III), Germany (MiD, III), Italy (V)	No
EU TRANSPORT policy need recommendation	
Option 1	Collect stage information

Tables 12 & 13: Information on travel distance information method of grouping.

Member state	Trip length grouping
Sweden (I), United Kingdom (I), Cyprus (II), Spain (II), Finland (III), Hungary (III), Switzerland (III), Germany (MiD, MOP, III), Belgium (IV), France (IV), Italy (V)	Continuous scale
Netherlands (I)	0.1-0.5km, 0.5-1.0km, 1.0-2.5km, 2.5-3.7km, 3.7-5.0km, 5.0-7.5km, 7.5-10km, 10-15km, 20-30km, 30-40km, 40-50km, >50km
Latvia (II)	<1km, 1-4.9km, 5-9.9km, 10-14.9km, 15-19.9km, 20-29.9km, 30-39.9km, 40-49.9km, >50km
Ireland (V)	<2km, 2-4km, 4-6km, 6-8km, >8km
Most common	
Range	Mostly reporting is possible on a continuous scale, although this does not necessarily mean that reports actually present information on such a scale.
Solution	Continuous scaling, and then rework to distance grouping as suggested below.
Post-harmonisation	
	Depending on the level of detail from data collection (which also depends on the technology used for filling in the travel diary) this can range from requesting the most detailed information from the Member States (continuous scale) to specific grouping. Currently, the most useful grouping option is on two levels : (1) Short distance - medium distance - long distance (2) <2km, 2-4km, 4-6km, ,6-8km, >8km
EU TRANSPORT policy need recommendation	
Option 1	continuous scaling
Option 2	<2km, 2-5km, 6-10km, 11-15km, 16-20km, 21-30km, 31-40km, 41-50km, 51-100km, 101-200km, 201-299km.

Member state	Distance limit for trips
Denmark (I), Germany (MOP, I) [24], Netherlands (I), Sweden (I), Norway (II), Finland (II), Germany (MiD, III), Belgium (IV)	no
United Kingdom (I)	Walk trips <1mile (but >50 yards) only on day 7
Spain (II)	Daily mobility; >5min for walk trip
Switzerland (III)	>25 meters (for a stage)
Italy (V)	>5min for walking trips; <20km trips. >20km trips are not included
Most common	
Range	Most have no distance limits reported. Question is whether this is somehow still reported in the travel diary user manual.
Solution	Theoretically, it would make sense to propose a lower limit in terms of distance travelled (i.e. 25m). In practice however, it is doubtful that people either (1) report such distances or (2) realise that such a low distance was a trip.
Post-harmonisation	
	Raw data selection (requires either raw data or contact person) to minimum requirement
EU TRANSPORT policy need recommendation	
Option 1	No limit

[24] The MOP does not foresee a trip distance limit in the survey but do so in the analysis.

Table 14: Information on time information collected and the method of grouping

Member state	Information on travel time
Denmark (I), Slovakia (PT, I), Sweden (I), Cyprus (II), Norway (II), Spain (II), Finland (III), Hungary (III), Germany (MiD, MOP, III), Romania (TPC, III), Switzerland (III), Belgium (IV), Czech Republic (IV), France (IV), Austria (V), Portugal (V), Italy (V), Lithuania (V)	yes
Netherlands (I)	1-5min, 5-10min, 10-15min, 15-20min, 20-25min, 25-30min, 30-45min, 45-60min, 60-90min, 90-120min, >120min
United Kingdom (I)	<15min, 16-20min, 21-30min, 31-40min, 41-60min, >61min
Latvia (II)	<5 min, 5-10min, 11-15min, 16-20min, 21-25min, 26-30min, 31-35min, 36-40min, 41-45min, 46-60min, >60min
Ireland (V)	yes (<15min, 15-30 min, 30-45 min, 45-60 min, >60 min)
Bulgaria (I), Estonia (I), Slovakia (PTB, I), Turkey (III)	no
Most common	
Range	Mostly, travel time is reported in minutes but with varying ranges.
Post-harmonisation	
	Preferential : reworking of raw data towards grouping of 1-5min, 5-10min, 10-15min, 15-20min, 20-25min, 25-30min, 30-45min, 45-60min, >60min. If not possible, than common denominator (<15 min, 15-30 min, 30-45 min, 45-60 min, >60min)
EU TRANSPORT policy need recommendation	
Option 1	<15 min, 15-30 min, 30-45 min, 45-60 min, 60-90 min, >90 min
Option 2	1-5min, 5-10min, 10-15min, 15-20min, 20-25min, 25-30min, 30-45min, 45-60min, 60-90min, >90min

Tables 15, 16 & 17: Information on geographical information collected and the method of grouping

Member state	Origin-Destination information
Bulgaria (I), Estonia (I), Netherlands (I), Slovakia (PT, I), Slovakia (PTB, I), Romania (TPC, III), Czech Republic (IV), Germany (MiD, III)	no
Denmark (I), Sweden (I), United Kingdom (I), Cyprus (II), Latvia (II), Norway (II), Spain (II), Finland (III), Hungary (III), Switzerland (III), Turkey (III), Belgium (IV), France (IV), Austria (V), Ireland (V), Portugal (V), Lithuania (V)	yes
Most common	
Range	Mostly, origin-destination information is collected. The format is however not mentioned. This may have important repercussions on the accuracy of the distance measurement.
EU TRANSPORT policy need recommendation	
Option 1	Postcode information
Option 2	Other options are : GNSS coordinates, map coordinates, address)

Member state	Road type
EU TRANSPORT policy need recommendation	
Option 1	highway, other main road, minor road

Member state	Area type
France (IV), Austria (V)	yes, not specified
Latvia (II), Germany (MiD, III)	no
EU TRANSPORT policy need recommendation	

Option 1	urban, non-urban/rural
Option 2	Other, depending on TF discussion under item 4

Table 18: Information on travel purposes

Member state	Description of travel purposes used for grouping of information
Bulgaria (I), Denmark (I)	Home, Work, Trade, Shopping, Leisure
Estonia (I), Sweden (I), Norway (II), Germany (MiD, III), Romania (TPC, III), Switzerland (III), France (IV), Austria (V), Italy (V), Germany (MOP, I)	Work, Education, Shopping, Business, Leisure (Estonia : combines 'work' & 'business'; Sweden : also includes 'escort' & 'other', Germany MiD : more detail possible; Switzerland & Norway : also includes "escort"; Italy : also more detailed)
Netherlands (I), Slovakia (I), United Kingdom (I), Spain (II), Finland (III), Hungary (III), Turkey (III), Belgium (IV), Ireland (V), Portugal (V)	Provide a more detailed listing than above, but can be reworked towards that listing.
Cyprus (II)	Work, Education, Shopping, Personal reasons, Leisure, Other
Latvia (II)	Work, Educational institutions, State and municipal institutions, Medical institutions, Employees business, Personal business, Escort, Other
Most common	
Range	This is a high level of variability in terms of the level of detail reported. However, in most cases, the level of detail can be brought back to match the initial five categories of "work, education, shopping, business and leisure".
Solution	A regrouping into a minimum set of travel purposes may be required. In many cases, the detailed categories cause overlap with broader groups.
Post-harmonisation	Optimal form possible of post-harmonisation
	Grouping to common denominator set of "work, education, shopping, business, leisure"
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	Work, education, shopping, business, leisure, other
Option 2	Home, work, trade, shopping, leisure
Option 3	Highly detailed listing (including the five base categories, but allowing for more precise purpose identification)

Table 19: Information on the use of different vehicle types and modes

Member state	Description of vehicle types used for grouping of information
Denmark (I), Germany (MOP, I), Slovakia (I), Norway (I), Finland (I), Switzerland (III), Germany (MiD, III), Romania (TPC, III), France (IV), Liechtenstein (IV), Austria (V),	Walking, cycling, other non-motorised, passenger car, other private motorised, bus, coach, rail, air, water, other public transport
Netherlands (I)	Walking/foot, pram/baby buggy, skates/skeelers, vehicle for physically disabled, bicycle, bicycle passenger, motorcycle/scooter, moped (<45kmh), moped (<25kmh), car driver, car passenger, bus, touring car/closed bus transport, train, metro, tram, delivery van, truck, camper, taxi, tractor, boat scheduled service, airplane, other
United Kingdom (I)	Walking, cycling, motorcycle/scooter/moped, car, private bus, taxi, minicab, stage bus, coach/express bus, excursion/tour bus, LT underground, surface rail, light rail, van/lorry, other private transport, air, other public transport
Hungary (III)	Cycling, motor/motorcycle, taxi/cab, train, subway, bus/coach/tram, car (driver), car (passenger)
Belgium (IV)	Walking, cycling, motorbike/moped, train, bus, tramway, underground, taxi, car driver, car passenger, other
Ireland (V)	Walking, cycling, motorcycle (driver), motorcycle (passenger), private car (driver), private car (passenger), bus (CIE/Dublin bus), bus (private operator), rail, Dart/Luas, Taxi/Hackney, Air, Boat/Ship, Van/Lorry (driver), Van/lorry (passenger), other
Portugal (V)	Walking, cycling, motorcycle, passenger car, regular bus, occasional bus, trolleybus, metropolitan, lift, another train, high-speed train, regular flight, non-scheduled flight, boat (river), boat (marine), other
Most common	

Range	High variability over countries (in particular level of detail changes). Most vehicle types and modes can be found. Country-specific detailed vehicle groups are often found.
Solution	In particular combination of "walking, cycling, other non-motorised, passenger car, other private motorised, bus, coach, rail, air, water, and other public transport" was found. However, may be due to information source formatting.
Post-harmonisation	Optimal form possible of post-harmonisation
	Merger towards common denominator (minimum grouping : walking, cycling, passenger car, other private motorised, bus&coach, train, other rail, other)
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	Passenger car, motorcycle/moped, bus/coach, metro/tram, train, cycling, walking, other
Option 2	Passenger car, motorcycle, bus, coach, metro, tram, train, moped, cycling, walking, other
Option 3	Walking, cycling, other non-motorised, passenger car, other private motorised, bus, coach, rail, air, water, other public transport
Option 4	Passenger car, taxi/minicab (hired private transport), van/lorry, motorcycle, stage bus, coach/express bus coach, metro, tram, train, moped, cycling, walking, other

Table 20: Information on the technical aspects of vehicles (technology used)

Member state	Description of fuel types used for grouping of information
Netherlands (I), Sweden (I), Cyprus (II), Switzerland (III), Germany (MiD, III), Belgium (IV), France (IV), Austria (V)	Is asked for in travel diary but no grouping available. Check in raw database if available.
United Kingdom (I)	Petrol, Diesel, Electric/Battery, LPG, Bi-fuel (petrol/gas), other
Most common	
Range	Some Member States collected information on the fuel type used. No information on categorisation was found.
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	Diesel, gasoline, hybrid, fuel cell, E.V., LPG, CNG
Option 2	Diesel, gasoline, diesel-hybrid, gasoline-hybrid, diesel-plug-in hybrid, gasoline-plug-in hybrid, bi-fuel, E.V., fuel cell, LPG, CNG
Option 3	Diesel, gasoline, diesel-hybrid, gasoline-hybrid, diesel-plug-in hybrid, gasoline-plug-in hybrid, E85 flexi-fuel, LPG/Petrol, CNG/Petrol, Other bi-fuel, E.V., fuel cell, LPG, CNG

Table 21: Information on the emissions linked to the vehicles

Member state	Description of categories of emission standards or similar categorisation, used for grouping of information
Most common	
Range	No information on emission standards was available from existing reports/projects. However, estimation may be made based on the vehicle age, working back to the most likely minimum emission standard that should have been met at the introduction year of the vehicle.
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	EURO I - EURO VI

PART 2: Medium and long distance mobility

Table 22: Medium & long distance - Information on the distance definitions used

Member state	Definition of long distance
Sweden (I), Norway (II), Finland (III), Switzerland (III), Belgium (IV), France (IV)	>100km (Norway : fly distance; Switzerland : at least on overnight stay; Belgium : not including commuting; France : on road network)
United Kingdom, France (IV)	>80km (UK : >50 miles travelled within UK, France : fly distance)
Spain (II)	>= 50km or <50 + one overnight stay
Denmark (I)	No specific definition: trips are reported regardless of their length.
Turkey (III)	Excursions: trips longer than 3 hours and not daily trips. Long distance : journey with at least one overnight stay
Germany (MiD, III)	At least one overnight stay
Most common	
Range	Definitions vary in terms of "the distance number" (50, 80, 100, …) and "the distance definition" (direct line, road network, …). No definition coincides with the currently proposed distance grouping (short distance : 0-299km, medium distance : 300-999 km, long distance : >1000km)
	None of the countries use a definition that is similar to the one proposed in the EU White Paper.
Post-harmonisation	Optimal form possible of post-harmonisation
	Use of common denominator : biggest "minimum distance" for data comparison. This is however currently not possible (mostly due to different measurement units : 50 miles vs. 50 or 100km. As a result, the best option would be to request detailed information from Member States and present grouping from that information onwards.
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	follow suggested distances : 0-299km (short distance), 300-1000 km (medium distance), >1000km (long distance)

Table 23 : Medium & long distance - Information on the type of vehicles used.

Member state	Description of vehicle types used for grouping of information
Denmark (I), Germany (MOP, I), Slovakia (I), Norway (I), Finland (I), Switzerland (III), Germany (MiD, III), Romania (TPC, III), France (IV), Liechtenstein (IV), Austria (V),	Walking, cycling, other non-motorised, passenger car, other private motorised, bus, coach, rail, air, water, other public transport
Netherlands (I)	Walking/foot, pram/baby buggy, skates/skeelers, vehicle for physically disabled, bicycle, bicycle passenger, motorcycle/scooter, moped (<45kmh), moped (<25kmh), car driver, car passenger, bus, touring car/closed bus transport, train, metro, tram, delivery van, truck, camper, taxi, tractor, boat scheduled service, airplane, other
United Kingdom (I)	Walking, cycling, motorcycle/scooter/moped, car, private bus, taxi, minicab, stage bus, coach/express bus, excursion/tour bus, LT underground, surface rail, light rail, van/lorry, other private transport, air, other public transport
Hungary (III)	Cycling, motor/motorcycle, taxi/cab, train, subway, bus/coach/tram, car (driver), car (passenger)
Belgium (IV)	Walking, cycling, motorbike/moped, train, bus, tramway, underground, taxi, car driver, car passenger, other
Ireland (V)	Walking, cycling, motorcycle (driver), motorcycle (passenger), private car (driver), private car (passenger), bus (CIE/Dublin bus), bus (private operator), rail, Dart/Luas, Taxi/Hackney, Air, Boat/Ship, Van/Lorry (driver), Van/lorry (passenger), other
Portugal (V)	Walking, cycling, motorcycle, passenger car, regular bus, occasional bus, trolleybus, metropolitan, lift, another train, high-speed train, regular flight, non-scheduled flight, boat (river), boat (marine), other
Most common	

Range	A wide range of vehicles is included in the general questionnaires. Mostly, these also cover relevant modes for medium- and long-distance travel.
Solution	In the case of medium- and long-distance travel, the selection of modes is relatively limited compared to short-distance travel. In particular the focus on a general selection of "road, rail, air, water" modes and a more refined selection of vehicle types (passenger car, bus/coach, regular train, high-speed train, aircraft, inland waterway vessel, and sea vessel) is more relevant.
Post-harmonisation	Optimal form possible of post-harmonisation
	At present focus on "vehicle type" grouping.
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	passenger car, bus/coach, regular train, high-speed train
Option 2	passenger car, bus/coach, regular train, high-speed train, aircraft, inland waterway vessel, sea vessel

Table 24 : Medium & long distance - Information on the fuel type used.

Member state	Description of fuel types used for grouping of information
Netherlands (I), United Kingdom (I), Cyprus (II), Switzerland (III), Turkey (III), Germany (MiD, III), Belgium (IV), France (IV)	Is asked for in travel diary but no grouping available. Check in raw database if available.
Most common	
Range	Some Member States collected information on the fuel type used. No information on categorisation was found.
Solution	In particular for medium- and long-distance travel, other than the conventional fuel types may be considered. This is largely due to the presence of air and water travel modes. General information is not collected through (for example) the tourism statistics. Rather, we need to consider looking at national reporting of fuel sales (different types)
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	Diesel, gasoline, hybrid, fuel cell, E.V., LPG, CNG
Option 2	Diesel, gasoline, diesel-hybrid, gasoline-hybrid, fuel cell, E.V., LPG, CNG

Table 25: Medium & long distance - Information on the type of travel purposes for which information is collected

Member state	Description of travel purposes used for grouping of information
Bulgaria (I), Denmark (I)	Home, Work, Trade, Shopping, Leisure
Estonia (I), Sweden (I), Norway (II), Germany (MiD, III), Romania (TPC, III), Switzerland (III), France (IV), Austria (V), Italy (V)	Work, Education, Shopping, Business, Leisure (Estonia : combines 'work' & 'business'; Sweden : also includes 'escort' & 'other', Germany MiD : more detail possible; Switzerland & Norway : also includes "escort"; Italy : also more detailed)
Netherlands (I), Slovakia (I), United Kingdom (I), Spain (II), Finland (III), Hungary (III), Turkey (III), Belgium (IV), Ireland (V), Portugal (V)	Provide a more detailed listing than above, but can be reworked towards that listing.
Cyprus (II)	Work, Education, Shopping, Personal reasons, Leisure, Other
Latvia (II)	Work, Educational institutions, State and municipal institutions, Medical institutions, Employees business, Personal business, Escort, Other
Most common	
Range	This is a high level of variability in terms of the level of detail reported. However, in most cases, the level of detail can be brought back to match the initial five categories.
Solution	The inclusion of an "other" category may be considered. In the case of long-distance travel, it may be better to limit to work/business and leisure (including holiday)
Post-harmonisation	Optimal form possible of post-harmonisation

	Grouping to common set of denominators "work/business" and "leisure (holiday)". The latter may be difficult since it assumes that the leisure category is sufficiently detailed filled in. This is not necessary the case. Combination with travel modes may work for air and water, but not for rail and road.
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	Personal/professional
Option 2	Work, education, shopping, business, leisure, other

Table 26: Medium and long distance – Information on the travel time

Member state	Information on day and time of day
Latvia (II), Switzerland (III), Austria (V)	yes
Most common	
Range	Day information is standard available. Time of day information is mostly not reported.
EU TRANSPORT policy need recommendation	Optimal solution for EU TRANSPORT policy needs
Option 1	weekday - weekend day

Tables 27, 28, 29 & 30: Information on demographical information collected

Member state	Gender
Denmark (I), Germany (MOP, I), Netherlands (I), Slovakia (PT, I), Sweden (I), United Kingdom (I), Cyprus (II), Latvia (II), Norway (II), Spain (II), Finland (III), Hungary (III), Romania (TPC, III), Switzerland (III), Turkey (III), Germany (Mind, III), Belgium (IV), France (IV), Austria (V), Ireland (V), Portugal (V), Lithuania (V)	yes
Bulgaria (I), Estonia (I), Slovakia (PTB, I)	no
EU TRANSPORT policy need recommendation	
Option 1	Collect information

Member state	family status & composition
Denmark (I), Germany (MOP, I), Netherlands (I), Slovakia (PT, I), Sweden (I), United Kingdom (I), Cyprus (II), Latvia (II), Norway (II), Spain (II), Finland (III), Hungary (III), Romania (TPC, III), Switzerland (III), Turkey (III), Germany (MiD, III), Belgium (IV), France (IV), Austria (V), Ireland (V), Portugal (V), Lithuania (V)	yes
Bulgaria (I), Estonia (I), Slovakia (PTB, I)	no
EU TRANSPORT policy need recommendation	
Option 1	Family status & composition should no longer be used. "Household composition" is preferred

Member state	Employment status or occupation
Denmark (I), Germany (MOP, I), Netherlands (I), Slovakia (PT, I), Sweden (I), United Kingdom (I), Cyprus (II), Latvia (II), Norway (II), Spain (II), Finland (III), Hungary (III), Romania (TPC, III), Switzerland (III), Turkey (III), Germany (MiD, III), Belgium (IV), France (IV), Austria (V), Ireland (V), Portugal (V), Lithuania (V)	yes
Bulgaria (I), Estonia (I), Slovakia (PTB, I)	no
EU TRANSPORT policy need recommendation	
Option 1	Collect information

Member state	car ownership
Estonia (I), Germany (MOP, I), Netherlands (I), Sweden (I), United Kingdom (I), Cyprus (II), Norway (II), Spain (II), Finland (III), Romania (TPC, III), Switzerland (III), Germany (MiD, III), Belgium (IV), France (IV), Austria (V), Portugal (V), Lithuania (V)	yes
Bulgaria (I), Denmark (I), Slovakia (PT, I), Slovakia (PTB, I), Latvia (II), Hungary (II), Ireland (V)	no
EU TRANSPORT policy need recommendation	

Option 1	Collect information