DEVELOPMENT OF A COMMON FRAMEWORK FOR RISK EXPOSURE DATA IN EUROPE

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ABSTRACT. Accident data provide limited information about the road safety phenomenon if they are not coupled with data on risk exposure (vehicle, passenger traffic, etc.). Within the framework of the European project SafetyNet, an EU common framework for collecting, processing and analyzing risk exposure data has been developed in order to allow for more meaningful road safety analyses. Within this common framework data concerning the road network, the driver population, the vehicle fleet, vehicle and passenger kilometers, the number of trips and the time in traffic were examined. Starting from the existing risk exposure data, best practices on methodologies to collect and process these data were explored and put into a proposal for a common framework to be used throughout Europe and allow for the availability of comparable risk exposure data. Special emphasis was given to the discussion on risk exposure in relation to time and to distance, showing the complexity of the task and the attention one should pay when making road safety analyses with risk exposure data. The gradual acceptance by the European countries of this common framework for risk exposure data is expected to upgrade significantly the possibilities for road safety analyses in the coming years and contribute thus to the achievement of ambitious targets of halving the number of fatalities in the European roads.

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INTRODUCTION

When road accidents or fatalities are to be compared between countries, the scale of different counties has to be considered: all other conditions equal, large populations tend to have more fatalities than smaller populations. The number of fatalities also depends on the number of vehicles i.e. on the level of motorisation. For instance, large populations with low level of motorisation have relatively low number of fatalities (Smeed, 1968). In this example, the population and vehicles figures are used as measures of exposure to the risk of road accident. A number of other measures may be used for this purpose as well. It is common practice to use the ratio of the number of accidents or casualties, divided by the amount of exposure for a comparison between counties. Such a ratio is called a "risk".

As far as accident data are concerned, the systematic efforts at EU level led to the creation of the CARE accident database (European Commission 1996, 2003), which includes the fifteen national accident databases with a significant number of harmonized data (common variables and values). This allows for comparisons of absolute numbers (counts) of accidents and related casualties at a satisfactory level of disaggregation (i.e. combined analysis per person, vehicle, road network and other characteristics).

On the contrary, as far as exposure data are concerned, a series of difficulties and limitations are encountered in road safety analyses. The problem that most often arises is that it is unclear whether exposure data are available and, when they are available, whether exposure data are comparable. In particular, exposure data collection efforts are carried out at the national level only, whereas no standard methodology for the collection and use of the data exists. The exploitation of this data is carried out mainly through the International Data Files (e.g. Eurostat, ECMT, IRTAD etc.), in which the national exposure estimates are available; however data comparability issues are to be dealt with.

The main purpose of the present analysis is to create the overall picture on current exposure data availability, collection methods and use, and identify the necessary improvements towards a common European framework for exposure data comparable over the Member States, to be combined with the existing road accident data (e.g. the CARE database) in order to provide usable risk estimates. This work was carried out within the scope of the SafetyNet project of the 6th Framework Program for Research, Technological Development and Demonstration of the European Union.

The analysis focuses on a set of exposure measures commonly used in practice, as follows:
- Road Length
- Vehicle Fleet
- Driver Population
- Vehicle Kilometres
- Person Kilometres
- Number of Trips
- Time in Traffic

These measures present different advantages and limitations. It is noted that the population of a country, also widely used as a measure of exposure, is not examined in the present analysis, as the respective data are fully available and compatible in several international databases (e.g. Eurostat, WHO etc.)

METHODOLOGY FOR THE DEVELOPMENT OF THE COMMON FRAMEWORK

For the assessment of data availability and compatibility and the development of the common framework, a two-stage methodology was adopted (Lejeune et al. 2005). Initially, an exhaustive literature review was carried out, allowing for the identification of the state-of-the-art in exposure data definitions, collection methodologies and use. The results showed that a number of alternatives exist when using exposure data in road safety analyses, according to the context. Moreover, different collection methods may exist and be applied in different countries for the collection of data on a particular exposure measure, and consequently the quality of the data may be largely influenced by the features of the respective collection method (SafetyNet, 2005).

At the same time, a short yet comprehensive questionnaire was sent to the EU Member States, including basic information of data availability and completeness. The analysis of the responses of the questionnaire allowed for a first classification of the EU Member States with respect to exposure data availability and data exploitation potential (SafetyNet, 2006). The results also confirmed the initial suspicion that, the most useful data (i.e. the more sophisticated exposure measures, such as vehicle- and person-kilometres of travel) are those that are the least available and usable. It was further indicated that usable data mainly concern road length, vehicle fleet, drivers' population and vehicle-kilometres data, whereas a lot of uncertainty was involved in the assessment of the compatibility of person-kilometres, time spent in traffic, and number of trips data.

Following these results, the collection of more detailed information was pursued. On that purpose, a second exhaustive questionnaire was created, presented as a "grid" in which respondents filled in the variables and values available for each exposure measure in their country. Moreover, respondents were asked to provide the definitions of each variable and value used in their country, and to specify the type and characteristics of the data collection method for each exposure measure.

According to the responses, the variables and values available for each exposure measure were compared for each country. In particular, their definitions were compared to the respective definitions of CARE or Eurostat, where applicable. Moreover, the data were compared separately for each collection method used; for example, vehicle kilometers data were compared separately for the countries using traffic counts systems and for the countries using travel surveys. Eventually, the compatibility of variables and values for each exposure measure, each country and each collection method was ranked according to the classification presented in Figure1, as follows:

- compatible values' definition
- probably compatible values' definition", indicating the case where the value is identical to a value used in CARE or Eurostat, but the related definition was not provided
- incompatible values or incompatible definitions, indicating the case where the value is not compatible to the respective value used in CARE (e.g. "highways" instead of "motorways"), or the related definition is not compatible (e.g. different country definition of "truck" than the one used in CARE).
- the value is not available

Compatible values (compatible definition)
Probably compatible values (unknown country definition)
Incompatible values or incompatible definition with CARE / EUROSTAT
The value is not available

Figure 1. Assessment of the compatibility of exposure data

Following this classification, summary Tables were created, allowing for an overall picture on the compatibility of exposure data in the European countries. The results are presented in detail in the following section.

CURRENT POTENTIAL FOR RISK EXPOSURE DATA IN EUROPE

Road Length

Figure 3 sumarizes the results of the availability and compatibility of road length data in the European countries. All countries except Spain and Italy reported data availability on road length. Moreover, all countries reported that the data are collected within national road registers. The variables and values of the CARE database of accidents and fatalities data, which may be combined with road length exposure data are area type (inside / outside urban area), road type (motorway or not) and region (defined by the standard European NUTS classification).

Variable	Value	AT	BE	CY	CZ	DE	DK	EE	EL	FI	FR	HU	IE	LT	LU	LV	MT	NL	NO	PL	PT	SE	SI	SK	UK
Area type	Inside urban area																								
	Outside Urban area																								
Road type	Motorway (yes/no)																								
	Road type groups																								
Region	NUTS																								
	Other																								
Surface type	Bituminous																								
	Gravel																								

Figure 3. Availability / compatibility of road length data (collected by: road registers)

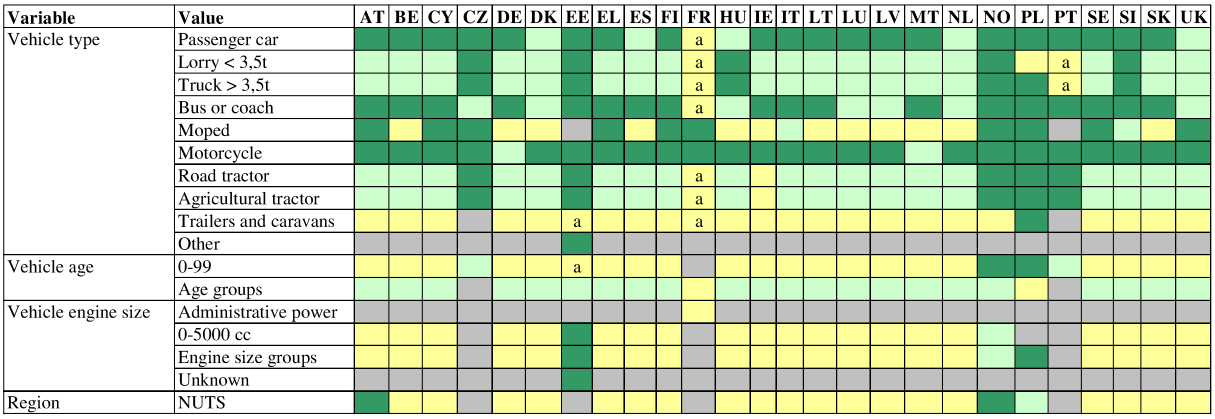
As regards area type, only 6 countries (EE, FR, PL, SI, SK, UK) have road length data classified inside / outside urban area, however it was not possible to verify whether the definitions of area type are in accordance to those used in CARE. Finland and Norway indicated that this data is not directly available but can be derived from the existing data. Moreover, 8 countries (CZ, EE, EL, FR, NL, NO, PL, SK) have road length data by NUTS region, whereas Austria and Belgium reported regional road length data by other classifications.

On the contrary, most countries reported having road length data for motorways, according to the definition of CARE. Moreover, most countries have data according to other road type classifications, which need to be aggregated under a value "not motorway", in order to be comparable to CARE accident data.

Overall, road length data per motorway (yes/no) and NUTS region are considered to be usable for a common framework of accidents and exposure data in Europe.

Vehicle Fleet

Figure 4 summarizes the results of the availability and compatibility of vehicle fleet data in the European countries. All countries reported data availability on vehicle fleet and that the data are collected within national vehicle registers. The variables and values of the CARE database that may be combined with vehicle fleet exposure data are vehicle type, vehicle age and region. However, an additional variable is examined, namely vehicle engine size, as a variable that is very likely to be included in future developments of CARE.



[a] coefficient required

Figure 4. Availability / compatibility of vehicle fleet data (collected by: vehicle registers)

The most usable results associated with vehicle fleet are those related to several vehicle types. Most countries reported data availability and compatible definitions with CARE as regards passenger cars, buses or coaches and motorcycles. As far as heavy goods vehicles are concerned, transformation rules may be required in most countries, since the definitions of the various values (e.g. lorry, truck etc.) could not be fully verified. Transformation rules are expected to be largely applied with respect to mopeds, due to differences in the national definitions among countries. Moreover, a lot of uncertainty is involved in the assessment of the compatibility of vehicle fleet data related to other vehicle types, such as road tractors, agricultural tractors, trailers and caravans, therefore this data is not considered to be usable in combination with CARE.

As regards vehicle age, the information is available in all countries except France, however there is some uncertainty for the compatibility of the definitions. Nevertheless, it is considered that it should be possible to define vehicle age groups that would be compatible with CARE.

Only Austria and Norway reported having vehicle fleet data by region (that is, the region where the vehicle was registered). In the remaining countries, the regional data are not compatible with the NUTS classification used in CARE. Finally, vehicle fleet per engine size, available in most countries, is not considered to be currently usable.

A particular case of vehicle fleet data concerns France, where vehicles aged higher than 15 years are automatically removed from the registers. Therefore, data from France can only be compared with those of other countries for vehicles aged less than 15 years, otherwise an appropriate correction coefficient needs to be developed by the national authorities, so that the available figures can be rescaled to the total vehicle fleet in France.

Overall, vehicle fleet data for passenger cars, buses or coaches, heavy goods vehicles and motorcycles per vehicle age are considered to be usable for risk estimates through the CARE accident data. The fact that this data is available in almost all countries makes this exposure indicator the most useful alternative for pan-European comparisons of traffic risk, allowing to deal with the lack of vehicle kilometers data observed in most countries (see next sections).

Drivers' population

Figure 5 summarizes the results of the availability and compatibility of drivers' population data in the European countries. All countries reported data availability on drivers' population and that the data are collected within national driving licenses registers. The variables and values of the CARE database that may be combined with drivers' population exposure data are driver age and gender, driving license age (indicating the experience of the driver), driver nationality and region (indicating the region where the driving license was issued).

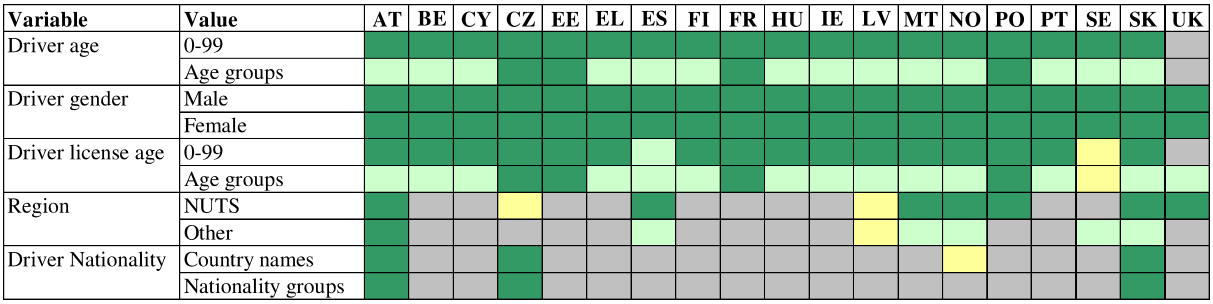


Figure 5. Availability / compatibility of drivers' population data (collected by: driving license registers)

The results indicate that 19 European countries have drivers' population data available in driving license register (all except DK, IT, LT, LU, SI that have not responded). Moreover, the variables and values available are almost fully compatible. In particular, all countries except UK have data by driver age, all countries except UK and the Netherlands have data by driving license age and all countries have data per driver gender. The age related individual values are largely available and therefore any age groups that would be compatible with the CARE age groups can be calculated.

The region where the driving license was issued is available in a few countries only and not always according to the NUTS regional classification, consequently this data is not considered to be usable. Moreover, only Austria, Czech Republic and Slovakia reported having drivers' population data by driver nationality.

It is noted that Germany and the Netherlands reported collecting drivers' population data by means of national surveys. The features of these surveys (sample size, coverage, sampling and measurement errors etc.) were not specified. In both countries, however, the surveys lead to the estimation of the drivers' population at national level per driver age and gender. The compatibility of this data with the data of other countries needs to be thoroughly examined.

Overall, however, the available information on drivers' population is considered usable for risk estimated in combination with CARE data; due to the nature of the variables and values examined, little or no transformation rules are expected to be required. Although driving license registers may lead to some overestimation of the real drivers' population, mainly due

to insufficient update of the registers (e.g. deceased drivers are often not removed), these issued are not expected to present large variations across countries, making the data comparable overall.

Given that this data is not currently available in international databases (e.g. Eurostat, IRTAD etc.), it is obvious that the gathering and exploitation of this data would be an important step for dealing with the lack of vehicle and person kilometers data.

Vehicle Kilometres of Travel

Traffic counts systems

Figures 6 and 7 summarize the results of the availability and compatibility of vehicle kiloemtres data in the European countries. Although vehicle kilometers is a more sophisticated and useful exposure measure, only 15 countries (AT, CZ, DK, DE, EE, FI, FR, HU, NO, PL, PT, SE, SI, SK, UK) have related data and the assessment of their compatibility is not straightforward. In this case, moreover, two main collection methods were reported, namely traffic counts systems and travel surveys, whereas some countries use both methods. The variables and values of the CARE database that may be combined with vehicle kilometers exposure data are different according to the collection method used.

Variable	Value	CZ	DK	EE	FI	FR	HU	NO	PL	SE	SI	UK
Vehicle type	Passenger car											
	Lorry < 3,5t											
	Truck > 3,5t											
	Bus or coach											
	Moped											
	Motorcycle											
	Road tractors											
	Other											
Road type	Motorway											
	Road type groups											
Driver nationality	Nationality groups											
Vehicle registration country	National											
	Foreign											
Year	Year											
Month/day/hour	1-12 / 1-31 / 0-23						a		a			
Area type	Inside urban area											
	Outside urban area											
Day of week	Day of week											
NUTS	Levels 1,2,3											

[a] month only

Figure 6. Availability / compatibility of vehicle kilometres data (collected by: traffic counts)

In particular, traffic counts systems are implemented in 10 countries, as shown in Figure 6. As indicated by the responses in the questionnaire, the characteristics of each system vary among countries, both in terms of coverage, type of road network and methods for obtaining the national estimates of vehicle kilometers (SafetyNet 2005). Moreover, only Hungary, Poland and Slovenia reported known errors in the exposure estimates. These parameters complicate the comparability of data between countries. Apart from these inconsistencies, which need to be addressed by the national authorities when the common framework is implemented, the compatibility of variables and values is quite satisfactory. In particular, almost all countries have data for passenger cars and light or heavy trucks; moreover, several countries have data for buses or coaches and two-wheelers. As regards road type, in most countries the distinction between motorways and non-motorways can be made. It is also possible to distinguish vehicle

kilometers traveled inside and outside urban areas in 4 countries (EE, NO, SI, UK). Given that traffic counts systems provide continuous measurements over time, yearly data should available in all countries (and monthly or weekly data were reported by a few countries).

Travel Surveys

Figure 7 shows that 11 countries collect vehicle kilometers data by means of travel surveys. It is noted however that the Estonian survey is an ad hoc survey for seat belt wearing rates and is unlikely to be compatible with the common framework. The characteristics of these surveys vary significantly among countries. For instance, frequency, sample size, overage, survey method (telephone, travel diaries etc.), response rate and measurement errors are some of the parameters that differ among the various national surveys. However, assuming that the method for producing the national estimates by the related authorities takes into account these features, the present analysis focuses on the compatibility of data in terms of variables, values and definitions.

Variable	Value	AT	DK	DE	EE	FR	NL	NO	PT	SE	SI	SK
Road type	Motorway											
	Road type groups										b	
Vehicle type	Passenger car											
	Lorry < 3,5t											
	Truck > 3,5t											
	Bus or coach											
	Moped											
	Motorcycle											
	Tractors											
	Others											
Vehicle age	Years											
Driver age	0-99											
	Age groups											
Driver gender	Male											
	Female											
Driver nationality	Nationality											
	Nationality groups											
Area type	Inside urban area											
	Outside urban area											
Fuel type	Gasoline											
	Diesel											
Year/month/day/hour	1-12/1-31/0-23	a										
Day of week	Day of week											
Seat belt use	Yes/no											

[a] year only

[b] public roads

Figure 7. Availability / compatibility of vehicle kilometres data (collected by: travel surveys)

Several countries have data for passenger cars and light or heavy trucks; moreover, several countries have data for buses or coaches and two-wheelers. As regards road type, in 5 countries (AT, DK, FR, PT, SI) the distinction between motorways and non-motorways can be made. It is also possible to distinguish vehicle kilometers traveled inside and outside urban areas in 3 countries (DK, NO, SI). Surprisingly, however, very few countries report data available per driver characteristics (age, gender etc.). It is likely that these surveys have other purposes than provide vehicle kilometers of travel; besides, vehicle kilometers is a measure concerning the vehicle and the driver (not all road users), consequently it is possible that person kilometers data would be more relevant within these surveys.

Other methods for obtaining national estimates

Overall, traffic counts systems appear to provide more data and more compatible values and definitions for more countries, although in theory travel surveys may provide more detailed information. A general problem rises from the fact that it is difficult to determine how the national estimate is produced on the basis of the results of the survey or of the traffic counts system. Furthermore, several countries reported other methods for obtaining national vehicle kilometers estimates.

For example, Denmark reports that the national vehicle kilometers estimates are obtained by means of vehicle odometer readings at regular vehicle inspections. Belgium reports a traffic census carried out every five years, leading to the national estimates. Several countries (BE CZ, EE, FR, NO, UK) mentioned a "combination of methods", however very few of them actually described these methods. In particular, the Czech Republic reports that the national estimates are produced by vehicle counts data and data obtained from public transport operators added up together. Estonia reports that the traffic counts data are combined with modeling results, in order to account for the amount of traffic corresponding to urban areas.

In view of the above, it is obvious that a lot of effort would be required for full data compatibility to be achieved in vehicle kilometers data in the European countries. However, basic figures per year, road type and vehicle type are currently considered not to be largely affected by these issues, and may therefore be comparable.

Person Kilometres of Travel

Travel Surveys

Person kilometers of travel are an even more sophisticated exposure measure than vehicle kilometers, as they may refer to all road users, including passengers and pedestrians. The main method for collecting this data is travel surveys. Only 9 countries responded using this method (DK, DE, FI, NL, NO, PL, SE, SK and UK - GB only). Moreover, Figure 8 shows that the definitions of the values collected are either incompatible among countries or their compatibility can not be assessed on the basis of the available information.

However, the amount of person kilometers traveled per person class, person age and gender appear to be compatible overall. It is noted that special consideration needs to be taken with respect to person age, given that the target age groups of the various national surveys present some differences and therefore data would be comparable only for a common subset of person age. As regards vehicle type, for most countries it was not possible to verify whether the definitions used are in accordance with those of CARE. All the issues mentioned in the previous section, namely the survey coverage and representativity, sample size and methods to produce the final estimates also need to be considered in this case. For example, the German survey covers passenger traffic only and the Polish survey covers urban areas only.

Variable	Value	DK	DE	FI	NL	NO	PL	SE	SK	UK*
Person class	Driver									
	Passenger									
	Pedestrian									
Vehicle type	Passenger car									
	Lorry < 3,5t									
	Truck > 3,5t									
	Bus or coach									
	Moped									
	Motorcycle									
	Bicycle									
Area type	Inside urban area									
	Outside urban area									
Road type	Motorway									
	Road type groups									
Year	Year									
Month/day/hour	1-12/1-31/0-23									
Day of week	Weekday/weekend									
Person age	0-99	a		b		d		c		c
	Age groups									
Person gender	Male									
	Female									

* UK only

[a] 10-84 from 1998

[b] 15-74

[c] 6-84

[d] 13-99

Figure 8. Availability / compatibility of person kilometres data (collected by: travel surveys)

Other methods for obtaining national estimates

Several countries (BE, CZ, DE, PL, SE, NO) indicated that they use a "combination of methods". These may range from estimations based on the multiplication of vehicle kilometers data with average car occupancy rates (e.g. Belgium, Norway), to a sum of data from surveys and public transport operators (e.g. Czech Republic) or statistical models using data from surveys, traffic counts, odometer readings and other sources (Germany, Poland, Sweden). Obviously, the more complex the estimation the more the data sources used, the more difficult the assessment of data compatibility. The integration of person kilometers data into a common European framework would therefore only be possible after a thorough examination of the data and related documentation in these countries.

Time Spent in Traffic

Finally, Figure 9 shows the data available for the time spent in traffic. This information is usually collected by means of travel surveys, together with the data on person kilometers. It is noted, however, that the time spent in traffic, together with the number of trips, is promoted by several countries against the distance traveled, especially when the surveys aim to the estimation of mobility.

Although 11 countries collect the time spent in traffic by road users by means of travel surveys, a rather poor data compatibility is identified. In particular, most surveys focus on passenger car traffic, whereas the definitions of the various vehicle types do not appear to be compatible (a number of transformations are required, for instance as regards two-wheelers). It is also interesting to note that Germany and the UK collect data for additional modes of transport, namely rail and air transport modes. Again, the data may be considered to be compatible only per person class, person age and person gender, whereas another variable that appears to be widely available and compatible is person nationality.

The uncertainty concerning the survey methods mentioned in the previous sections is also encountered in this case. In general, time in traffic is likely to follow the trends described by person kilometers quite closely. The main difference is that time in traffic may to some degree account for the development (differences in) the average travel speed. Moreover, the background idea may be different: only while being involved in traffic – moving or halted – one is exposed to being involved in an accident.

However, apart from the incompatibilities discussed above, other difficulties that may be encountered in the disaggregation of time spent in traffic, especially as regards comparisons. For example, comparing the time spent in traffic between motorways and urban areas, or between riding a bicycle, sitting in a bus and driving a car, may be complicated (SafetyNet 2005). For these reasons, the time spent in traffic is considered marginally usable in European comparisons and the incorporation of this exposure measure into the proposed common framework is not currently feasible.

Variable	Value	BE	DE	DK	FR	FI	MT	NO	NL	PL	SE	UK
Person class	Not defined											
	Driver		a	b								
	Passenger		a									
	Pedestrian											
	Motorcycle rider											
	Moped rider											
	Cyclist											
Vehicle type	Pedestrian											
	Passenger car											
	Car (as driver)											
	Car (as passenger)											
	Bus or coach											
	Moped											
	Motorcycle											
	Mofa, moped, motorcycle											
	Bus											
	Tram											
	Metro											
	Train											
	Airplane											
	Other											
Vehicle age	0-99											
	Age groups											
Vehicle engine size												
Area type	Inside urban area											
	Outside urban area											
Year	Year											
Month/day/hour	1-12/1-31/0-23											
Person age	0-99	d		e	d	d						
	Age groups		c	e								
	Unknown											
Person gender	Male						f					
	Female											
	Unknown											
Person nationality	Country names											
	Nationality groups											
Driver license age	Year											
	0-99								g			
	Age groups											
Region	NUTS											

[a] Passenger cars only
[b] Including cyclists
[c] year of birth available
[d] 6-99 only
[e] 15-99 only
[f] 10-99
[g] Dutch only

Figure 9. Availability / compatibility of time spent in traffic data (collected by: travel surveys)

SUMMARY OF THE COMMON FRAMEWORK

The above analysis revealed the current potential for the exploitation of the existing exposure data available at national level, for risk comparisons between European countries by means of combinations with the available CARE accidents database. In particular, the analysis aimed to the identification of subsets of variables and values for each exposure measure, that are collected and processed through the same method and that are subject to common definitions, also compatible to those of the accident data. Despite the fact that some countries did not fully respond to the exhaustive questionnaire used, an important amount of detailed information was obtained. It is also important to note that an important amount of related documentation and references were provided by the countries, allowing for a more in-depth analysis to be carried out in next stages of this research.

Overall, following the analysis it can be deduced that the following exposure data are widely available and currently comparable among European countries (i.e. in the countries where they are available):

- road length data collected in national road registers, per motorway (yes/no) and per NUTS region
- vehicle fleet data collected in national vehicle fleet registers, per vehicle type (passenger cars, buses or coaches, heavy goods vehicles and motorcycles) and per vehicle age
- drivers' population data collected in national driving license registers, per driver age, driver gender and driving license age
- vehicle kilometers estimated by traffic counts systems, per motorway (yes/no) and per vehicle type
- vehicle kilometers and person kilometers estimated by travel surveys, per person class (driver, passenger), person age and person gender

It is interesting to note that a different combination of variables is compatible for different exposure measures. For instance, the exposure per region and road type can be estimated through road length only, whereas the exposure per vehicle type and road type can be estimated through vehicle kilometers collected by traffic counts only. Moreover, it is quite obvious that the more sophisticated data and methods are associated with poorer compatibility and greater need for transformations, not allowing in some cases (e.g. time spent in traffic) to include them in the common framework for current data exploitation potential.

From the results of the present research, it is obvious that comparing risk rates, especially at international level, may be a very complex task. Especially as far as exposure data is concerned, in theory, continuous exposure measurements of different road user categories in different modes and different road environments would be required and could provide detailed exposure estimates to the degree of disaggregation of the respective accident data. In practice, such measurements are not possible. Consequently, road safety analyses need to compromise to some (approximate) estimates of exposure, which may be more or less accurate and representative of the true exposure of the examined population.

Although the most appropriate and recommended measurements of exposure appear to be vehicle- and person -kilometres of travel, as well as time spent in traffic, because these measures are conceptually closer to a theoretical definition of exposure (Hakkert and Braimaister, 2002), they cannot be collected in the required level of detail on other than a systematic basis. In several countries, different systems exist and national exposure estimates

are produced, whereas in some countries no data on vehicle- or person-kilometres are available. Therefore, other exposure measures are often used; namely the vehicle fleet and the drivers' population, the road network length, as well as the population figures. Although this data concern cruder exposure estimates and can replace the vehicle and person-kilometres only under specific conditions, they are widely used for the calculation of accident risk rates, mainly because they involve less complex collection methods and can more easily lead to comparable figures.

Vehicle- and person-kilometres of travel, as well as time spent in traffic can be collected through (national) travel surveys. However, these surveys are carried out by personal interviews on a sample of the entire population (and in some cases an age threshold is in place). Additionally, a number of possible biases (sampling, non response or measurement errors) may occur and should be treated accordingly where possible. Moreover, travel surveys often have main purposes other than to provide exposure data. On the other hand, traffic counts systems, which are also widely used for exposure estimates, are not suitable to distribute exposure according to person characteristics (age/gender groups). Additionally, this method is also sample-based; however the seasonal (e.g. weekly, daily, hourly) variation of exposure can be estimated.

The international comparability among the produced exposure data is often limited, mainly because of several incompatibilities among the national definitions (road network, vehicle categories etc.) and/or characteristics (different use of various transport modes in different countries e.g. mopeds and motorcycles). Additionally, as mentioned previously, data from different sources (collection methods) may be used to produce a national exposure estimate, i.e. different data sources may function complementarily for the calculation of a single exposure measure. In general, it is not always clear how the exposure estimates are obtained from the "raw" data collected by means of the various methods.

TOWARDS A FUTURE PAN-EUROPEAN FRAMEWORK FOR RISK EXPOSURE DATA

Despite the difficulties discussed above, from this research it is demonstrated that there is potential for road accident risk investigation at European level. The development of the CARE European for the collection and analysis of accident data is a major step forward in this direction. However, the absence of a system similar to CARE for exposure data collection and exploitation considerably limits the possibilities of reliable and useful analyses of accident data, including the analysis of risk rates.

Summarizing, the availability and compatibility of exposure estimates in the European countries varies significantly, and is related both to the exposure measures used and the characteristics of the respective collection methods. In particular, significant efforts are made at national level to improve data availability, disaggregation and reliability; however the lack of a common European framework for the collection and exploitation of RED compromises the comparability of the detailed national data. It is also obvious that the most useful exposure measures are the least available (Golias and Yannis, 2001).

Further work and research should therefore focus on data compatibility and availability, namely through a common framework including common data requirements and definitions and a pan-european data collection system. In particular, this future framework should focus

on the collection of disaggregate time series of exposure data by road user, mode and network characteristics, and should be organized to provide data in a consistent and systematic way. This common future European framework should mainly focus on the more sophisticated exposure measures, namely vehicle- and person-kilometres of travel, as well as the time spent in traffic. Moreover, given that the different collection methods used for these estimates, namely travel surveys and traffic counts, present different features and difficulties, a future common exposure data collection framework should include both travel survey and traffic counts elements. The specific elements of the calculation process of exposure measures would be an important and complex task.

The establishment and operation of such a system would be a complex and time-consuming task, which would also involve a significant effort and cost, both at national and European level. In order to deal with the current needs, the gathering and harmonization of the existing information shall certainly contribute to the improvement of the potential for exploitation of the existing exposure data. The harmonization of the definitions of exposure measures, variables and values between countries, in accordance to the existing CARE accident data, would be an important first step to improve comparability of the existing data.

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