Data on mobility and safety

Enrique Cabello
Universidad Rey Juan Carlos, Spain
enrique.cabello@urjc.es

Fermina Sanchez
Observatorio Nacional de Seguridad Vial. Dirección General de Tráfico, Spain
fesanchez@dgt.es

Isaac Martín
Universidad Rey Juan Carlos, Spain
isaac.martin@urjc.es

Ana Belén Cabello
Universidad Rey Juan Carlos, Spain
anabelen.cabello@urjc.es

Maartje de Goede
TNO, Soesterberg, Netherlands
maartje.degoede@tno.nl

Richard van der Horst
TNO, Soesterberg, Netherlands
richard.vanderhorst@tno.nl

Cristina Conde
Universidad Rey Juan Carlos, Spain
cristina.conde@urjc.es

Pilar Romay.
St. Paul CEU University, Valencia, Spain
pilar.romay@gmail.com

'Six honest servants taught me all I know.
Their names are: Who, When, Why, Where, What and How'
Rudyard Kipling

Summary

The urban expansion, the motorization, the work and shopping concentration in the cities outskirts have caused a constant increase in the travelling distances. Therefore, walking is getting more and more difficult and dangerous.

On the other hand, there is a great diversity of pedestrians with different requests or needs when using the urban and non-urban space, depending on their age, their movement capacity and the kind of trips they need to make, where and how (carrying any bundle or without any weight). On the other hand, as a road users group, they all share some basic safety and mobility requirements related with the environment quality and attractiveness, accessibility, signalization, comfort and capacity, interconnectivity and ease of movements in

general. When those requirements are not fulfilled, some pedestrians´ groups are more affected than others (children, old people…).

Good information on the actual conditions of pedestrians´ mobility and safety and better information on their own perceived difficulties and wishes can help to detect what are the basic needs to be met, so the most vulnerable road users can easily choose to walk more frequently. The city and all it spaces must be accessible (accessibility norms) for all the citizens, independently of their age and different characteristics. The space they have to use when they walk out of towns also has to be easy, attractive and safe.

Until now, available knowledge of the walking conditions and the safety of those road users have been incomplete and lacking in quality. The walkability of the pedestrians´ environment could be improved if policy makers had correct and detailed information on the actual quality needs of pedestrians in general and the specific needs of different groups of these road users.

In that sense, different sources of information on pedestrians can be considered:

a) Direct measurements

These are measures which are obtained by means of direct observation and data retrieval from a certain source. Therefore, such measures are directly captured from an instrument (in the wide sense), achieving concrete values for a certain measurement variable.

In the field of Road Safety the survey is the method most widely used to know about user's personal opinions, perceptions of needs, or self-reported difficulties with regard to mobility and safety. There is a huge disparity in the kind of data, periodicity and number of subjects considered in these studies. Different levels of Public Administrations are involved and, sometimes, surveys at three different levels can be found: local, regional or national level. But normally the mobility surveys mainly address drivers, and only little information on pedestrians can be obtained, not even the information on drivers-when they move as pedestrians.

Direct information is also the automatic data obtained by cameras or other devices used to measure the mobility of pedestrians in public spaces. Video recording is commonly used when making behavioural studies in road traffic. In order to know about mobility of pedestrians in small places or to study the pedestrian behaviour in selected streets, it is important to record it in videos and analyse them to obtain, for example, crossing behaviour patterns or to analyse conflicts between pedestrians and vehicles.

There are many examples of the usefulness of these video-based approaches. For instance, the work by Richard van der Horst (Van der Horst,1990) uses an application called VIDARTS (VIDeo Analysis of Road Traffic Scenes), where he makes a direct use of time-related measurement such as TTC (Time-to-Collision) and TLC (Time-to-Line-Crossing) as a cue for decision making in longitudinal and lateral control of the vehicle. Other time-related measures, such as the TTI (Time-to-Intersection) and TTS (Time-to Stop-Line), serve as adequate measurement for modelling driver behaviour when negotiating intersections.

One example of video analysis is a system currently used in Stockholm city (Laureshyn, 2009) to detect biking in the "wrong" direction and analyse traffic conflicts between cyclists and other road users, including pedestrians. This is done by detecting simultaneous presence of various road users in a certain area, extracting their position and speed, since video analysis provides a continuous description of road user's trajectories and speed profiles, which are important parameters to calculate safety-related indicators.

Yet, another example of a sequential analysis of the evolution of pedestrian trajectories on the crossings is the one which was computed for the detection of pedestrian-vehicles conflicts, in the work by Enrique Cabello (Cabello, 2006).

b) Indirect measurements

We consider as indirect measurements those obtained by analyzing the information provided by other means. The indirect measures showed are mainly related to pedestrian accident analysis and the information on the use of public transport.

The social impact of pedestrian accidents raises the need of knowing what happens and how. These data reflect the options they take related with time and space (days in the week, hours in the day and also some streets preferred to others), as well as the mode of public transport chosen (underground, bus, tram) associated to walking also indirectly may indicate the way they find the solution to some needs.

Usually the degree of safety is measured by the number of accidents or victims. In this sense, differences between countries reflect economic, social, infrastructural, topographical and climate conditions and, maybe, differences in policies. But there are some problems with sources of pedestrian accidents data: The most important information source for quantitative statistical crash analyses are data collected by the police or similar agencies at the national level. This is the kind of information more at hand or available. However, the weaknesses of this source of information for pedestrians´ casualties are well established almost literally quoting (ETSC report, "…." 2005a). Definition of pedestrian accident is somehow discriminative and not very good. There are problems in terms of:

- *Comprehensiveness and quality:* The data are most often based on a limited number of variables describing crash characteristics and they provide very little information about the conditions of the affected road users, not about the consequences of crashes and resulting disabilities. The completeness and accuracy of these data is not always satisfactory.
- *Underreporting:* Pedestrians (like cyclists) are heavily and disproportionately underrepresented in the police crash statistics, compared to what hospital records and other studies show (OECD, 1998). Normally the "pedestrian solo" accidents are not included. Pedestrian accidents of this kind, that do not involve any vehicle, are connected with the road footway maintenance, and their monitoring should be represented as an integral element of any sustainable transport, mobility and accessibility policy.

1. Pedestrians´ mobility, safety and reported needs.

1.1. Surveys and other data comparison by country: What we know.

Most pedestrians' safety problems are common to all European countries: Their mobility conditions have been negatively affected by the car use and the priority given to the car driving. Walking has declined over the last few decades, mainly because of the lack of accessibility, the lack of comfort, the environmental pollution and the cities unsuitable design. European countries have made several efforts in order to give priority to walking in urban areas and the target is to strongly reduce pedestrian fatalities.

Requirements to satisfy pedestrians´ quality needs, in the pedestrian-driver-vehicle-environment system, are determined by:

a) equipment
b) social environment
c) Transport system
d) Pedestrians´ abilities to manage themselves independently
e) Social values

Therefore, broader understanding of the decisions taken by the pedestrians has to include information on aspects such as the effect of ageing on their walking decisions, their concerns about security or the impact of economic and weather conditions. The social values will also influence the choices people make in relation to the transport they use to go to work, to school, to get to their leisure and sport activities.

Besides that the mobility studies mostly refer to drivers, one of the main drawbacks of the available data about mobility in Europe is the lack of a unified survey system. Almost all countries have their own survey, mainly designed to fulfil its own needs, but without a standardized procedure and quality.

The lack of a unified European survey has several main effects. Following are the most important:

- Sets of data are roughly comparable. Definition of words (trip, journey, period of time considered) can change between countries. The way which the survey is gathered can also change: by phone, by mail...
- Information is sparse on several countries web pages, some of them written in the national language. Most of these national level mobility surveys have English translation, but some of them translate only the main figures. So, even when the information is available, it is hard to find it in short time or just by clicking on few web pages.
- In addition to this national level, there are a huge number of local or regional web pages with mobility data. Web pages containing surveys with non-standard data provided by European funded research projects are placed everywhere. These kinds of data are usually tailored to the project or to the local problem, and therefore hard to compare with others.
- Surveys about mobility over short distances are mainly focused on cars or public transport. Maybe the underlying interest is the usability of these figures by local governments to collect information about its own networks of public transport. For long distances it is almost always assumed that cars or public transport are the only alternatives.

Over the next few pages, main information about mobility and safety in Europe are presented. Table I is a summary of national surveys. Following these, some figures and data about several aspects of mobility are considered. Other tables show pedestrians killed and injured in Europe.

For the collection of empirical data the STSM report, the ERSO website, ETSC Fact Sheets and national statistic, ARE(2000), Deutsche Institut für Wirtschaftsforschung (DE, 2003), Department of Transportation (UK, 2004), Bureau of Transportation Statistics (CH, 1995) and, internet sites has been used. In order to adequately update the figures in Table I, we have used the information in the last available reports from individual national Surveys, in each of the involved countries.

Information on MOBILITY:

Table I Summary of National Surveys

Country	Responsible (survey)	Survey	Fieldwork period	Age	Sample size	Information collected
BE	Federal Services of the Scientific, Technical and Cultural Affairs	Belgian national mobility survey LIMOBEL	December 1998 – November 1999	> = 6	9.459 households	Trips during a pre-selected day
DK (excl. Greenland,Faroe Islands)	Synovate and Danish transport Research Institute	Survey of Transport Behaviour (TU).	2006, 2007, 2008	10 – 84	Approx. 2.400 people per month	Traffic behaviour during the 24 hours prior to the interview
DE	German Federal Ministry of Transport, Building and Housing	German mobility panel	Autumn 2007, during one week	> = 10	904 households 1.567 people	Mobility behaviour of complete households during one complete week
ES	Ministry of Fomento (Transport)	1st part of the Mobility survey of the resident people in Spain: "MOVILIA 2006/2007", survey on short distance mobility	4th quarter 2006 (October-December) and January 2007	All	49.027 people residing in Spain	Mobility in a working day Mobility in a weekend day (Saturday or Sunday) Interview of a maximum of 4 members of each household
FR	INSEE	Survey of transport and communication	May 2007 – April 2008	> = 6	20.220 households	Daily trips during the day before and last weekend Long distance trips during the previous three months
LV	Central Statistical Bureau of Latvia	Short Distance Mobility Survey	19 May 2003 – 5 June 2003	> = 6	2476 households 6208 people	Mobility on the day prior to the interview Short distance (up to 100km according to the EU standards)
NL	Statistics Netherlands	Mobility Research Netherlands (MON)	2008	All	21.960 households 7.233 people	Journeys during one day
AT	Austrian Ministry of Transport	Austrian mobility survey	September 1995 – December 1995	> = 6	12.400 households	Daily trips during one day Trips longer than 50 km during one 14 day period
PT	National Statistical Institute	Portuguese medium and long distance mobility survey	May 1998 – June 1998	> = 15	41.845 households	Medium and long distance trips longer than 50 km
FI (excl. Åland islands)	Finnish National Road Administration, Traffic and Road Research	Finnish national travel survey	June 2004– May 2005	> = 6	20.075 people	All trips made during the survey day Over 100 km trips made during 28 days before the survey day
SE	Swedish institute for transport and communications analysis	Swedish national travel survey	October 2005 – 30 September 2006.	6 – 84	27.000 households 41.000 people	Daily mobility during one day Long-distance journeys exceeding 100 km one-way made during previous 30 days. Long-distance journeys exceeding 300 km one-way made during previous 60 days
UK (excl. Northern Ireland)	Office for National Statistics	National travel survey	January 2007 – December 2008	All	8.100 households	All personal travel within Great Britain reported in a seven-day diary for every household member. Short walks of less than a mile recorded only on the last day of the diary
NO	Institute of Transport Economics	Norwegian travel survey	2 January 2005 – 15 January 2006 A new survey will be carried out in 2009/2010	> = 13	17.500 people	Mobility during one day Any long distance trip (exceeding 100km) undertaken during the last month before the interview
CH	Swiss Federal Office for Spatial Development – Swiss Federal Statistical Office	Microcensus on travel behaviour	January 2005 – December 2005	> = 6	31.950 households 33.390 people	Concrete travel behaviour during the reference day Interview of one or two members of each household

In Table I remarkable differences can be appreciated in studied variables like the age of the population considered, the sample size or the information collected, which makes comparisons very difficult.

Table II Passenger mobility in Europe

Country	Year	Population covered – age	Average number of trips / person / day	Average travel distance (km) / person / day	Average total travel (min) / person /day
BE	1999	> = 6	3.0	:	:
DK	2001	10 – 84	2.3	30.1	40.7
DE	2002	> = 10	3.5	38.5	79.2
ES	2000	All	1.9	:	46.0
FR	1993-1994	> = 6	2.9	35.3	58.2
LV	2003	> = 6	1.9	8.7	13.0
NL	1998	All	3.4	33.6	66.1
AT	1995	> = 6	3.0	28.1	68.8
FI	1998-1999	> = 6	2.9	45.8	84.3
SE	2001	6 – 84	2.8	44.2	:
UK	1999-2001	All	2.8	29.9	59.2
NO	2001	> = 13	3.1	37.0	62.0
CH	2000	> = 6	3.6	47.6	88.8

Table II shows that in the European countries people make on average 3 trips per day and travel between 30 and 40 kilometres per day. But we do not know the number of trips made only by foot, or walking between other modalities.

Table III Average travel time/person/day (in minutes)

Country	Passenger car	Total
NO	38,9	68,2
CH	35,3	84,5
DE	43	80
ES	18,9	44,4
FR	39,0	58,2
UK	36,5	59,7
NL	32,4	59,9
AT	33,0	68,8
FI	37,7	70,7
SE	35,0	62,6

In Table III it can be seen that in the European countries with available data people spend on average an hour per day travelling. More than half of this time is spent on travel by car.

The purpose of travelling is described in Table IV. Leisure activity is the main reason, accounting for more than 40% of the time spent on travel in most of the countries with available information. Work is the second most important reason for travel.

Table IV Distribution of trips by main purpose

In percent	BE	DK	DE	ES*	FR	LV	NL	AT	PT	FI	SE	UK	NO	CH
Escort	13.9	-	-	8.3	-	3.6	-	-	-	-	-	12.6	13.0	4.8
Work/school	27.2	29.2	26.0	53.1	33.9	49.9	26.3	47.3	44.2	29.6	31.9	25.3	22.0	35.5
Shopping/personal business	28.0	29.2	40.6	8.2	32.7	22.8	23.3	21.3	7.2	21.3	21.2	31.3	25.0	19.1
Leisure	30.3	29.2	33.3	18.6	33.3	15.2	32.7	29.0	44.6	49.1	34.0	26.5	30.0	39.5
Other	0.5	12.5	-	11.8	-	8.5	17.7	2.4	4.0	-	12.9	4.3	10.0	1.0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table V Share of kilometres travelled

Share of kilometres travelled (percentage)	Leisure	Work/School	Shopping/private business	Escort	Others	Total
Switzerland	44,8	35,0	11,2	4,9	4,8	100
Germany	38,3	29,7	21,7	4,5	4,8	100
UK	33,7	32,0	19,7	7,6	7,1	100

Table V indicates that people travel longer distances for leisure and work/school purposes, while shorter trips are made for the other kinds of reasons. Sources: Deutsche Institut für Witschaftsforschung (DE, 2003), Department of Transportation (UK, 2004), Bureau of Transportation Statistics (CH, 1995).

Table VI Personal Travel Mode Split of Various Countries.

Country	Year	Public Transport	Bike	Walk
Latvia	2003	32%	5%	30%
Switzerland	2005	12%	5%	45%
Netherlands	2006	5%	25%	22%
Spain	2000	12%		35%
Sweden	2006	11%	9%	23%
Austria	2005	17%	4%	21%
Germany	2002	8%	9%	23%
Finland	2005	8%	9%	22%
Denmark	2003	8%	15%	16%
Norway	2001	10%	4%	22%
UK	2006	9%	2%	24%
France	1994	8%	3%	19%
Belgium	1999	6%	8%	16%
Ireland	2006	11%	2%	13%
Canada	2001	11%	1%	7%
Australia	2006	8%	1%	5%
USA	2001	2%	1%	9%

Table VI points out some results of a study by (Bassett, et al., 2008) that uses various data sources to calculate overall travel (mileage) and mode split (percentage of trips) by walking, cycling and public transport for various countries. Again, it is important to note that an exhaustive comparison between them is difficult, as every country measures a different set of features.

Table VII Mode Split In Selected European Cities

City	Foot and Cycle	Public Transport	Car	Inhabitants
Amsterdam (NL)	47 %	16 %	34 %	718,000
Groningen (NL)	58 %	6 %	36 %	170,000
Delf (NL)	49 %	7 %	40 %	93,000
Copenhague (DK)	47 %	20 %	33 %	562,000
Arhus (DK)	32 %	15 %	51 %	280,000
Odense (DK)	34 %	8 %	57 %	1,983,000
Barcelona (Spain)	32 %	39 %	29 %	1,643,000
L'Hospitalet (Spain)	35 %	36 %	28 %	273,000
Mataro (Spain)	48 %	8 %	43 %	102,000
Vitoria (Spain)	66 %	16 %	17 %	215,000
Brussels (BE)	10 %	26 %	54 %	952,000
Gent (BE)	17 %	17 %	56 %	226,000
Brujas (BE)	27 %	11 %	53 %	116,000

Table VII shows the mode split mobility in various European cities (from ADONIS, 1998). The number of inhabitants does not make a clear difference. Probably, it is more a matter of suitable conditions than a question of the size of the city.

1.2. Specific information on pedestrians' mobility

Better information on the conditions in which pedestrians move gives the possibility of the evaluation of needs to be covered in order to reach higher levels of Road Safety and pedestrian satisfaction. The reasons of or motives for choosing (or not) to travel by foot is very important information that is normally overlooked. Health, economy, accessibility, comfort, interconnectivity, security, ease of movements and also the individual conditions are characteristics that may influence the decision of walking.

Specific surveys on pedestrian opinions and experiences are very infrequent. Information usually focuses on norms to cross the roads**.** Normally, only the opinions of experts have been used to consider and evaluate the situation on different countries and the way to promote walking.

One specific example of that kind of surveys, is the "Pedestrians Attitudes and Behavior" carried out in the summer of 2002 by the National Highway Traffic Safety Administration of the United States Department of Transportation, Washington, DC. The sample included 9.616 people, from 16 years old onwards.

About 86 % of people aged 16 or older walked, jogged or ran outdoors for 5 minutes or more during the summer months, with 78 % doing so within the 30 days prior to the survey. For the group over 64 years old, walking during those 30 days decreased to just 66 %. An estimated 13.33 billion walking trips were made in the summer months of 2002, with 74 % of all trips being made by frequent walkers. Personal errands (38%), exercise (28%) and recreation (21%) are the most common reasons for trips. Nearly half (45%) of the trips were made on sidewalks, and 25 % were mostly on paved roads. Just 6 % were made either on bike, walk paths, or trails. About 6 % of pedestrians felt their personal safety threatened on their most recent trip, with 62 % saying they felt threatened by motorists. Almost three-quarters of people 16 and older (73%) are satisfied with how their local community is designed for walking; though one-third would like to see changes including more sidewalks (42%) and more lights (17%).

In the Netherlands there is another, more comprehensive, pedestrian survey (Mobility 2008) that includes distance covered by foot, number of trips as a pedestrian (both as door-to-door and as multi-modal trips), specific groups and situations.

In Spain (Movilia, 2007) the collection of data during the first stage of the survey, was carried out by directly visiting people at their homes, during the last quarter of 2006.

On weekends, different modes of movement include 47% on foot (for more than 5 minutes), compared to 46% by car or motorbike, and 4% by urban bus or underground; the remainder is distributed between trips by intercity bus, train and others. Also on weekends, the time consumed by movement is larger due to walking trips, which consume approximately 45 minutes. This is longer than the average time dedicated to work, study, shopping, escorting, leisure, visiting and others.

During work days, modes of movement include 46% on foot (for just 5 minutes), against 42% by car or motorbike, and 7% by urban bus and underground; again, the remainder is distributed between intercity bus, train, and some others. As in the previous section, the

largest figure is the time devoted to walking trips, which compose a total expense of around 45 minutes.

A more detailed comparison of these issues, with concrete figure, is provided in Table VIII.

Table VIII Walking trips duration and purpose

Walking time /day U.S. (Survey 2008)	86% of the sample walked 5 minutes/day or more during the summer. 78% had walked during the previous 30 days. 65% of the group ≥ 65 years old had walked the previous 30 days
Walking time /day Spain (Movilia 2007)	47% on foot (for more than 5 minutes), 46% by car or motorbike, and a 4% by urban bus or underground during weekends
Walking time /day Netherlands (Mobility 2008)	22% on foot , 20% bicycle, 53% by car + others 5%

Walking trips purpose	**Private business**	**Leisure**	**Exercise/health**	**Travelling to Work/School**
U.S. (Survey 2008)	38%	21%	28%	5%
During weekends Spain (Movilia 2007)	**Visit 19% Escorting 4% Shopping 14%**	**Leisure**	**Walking on foot 20% Others10%**	**Travelling to Work School**
Spain	37%	25%	30%	8%
During weekends Netherlands (Mobility 2008)	**Business Visit 0,5 % Visit 25 % Shopping 24 %**	**Leisure**	**Walking on foot 18% Exercise 2% Others 4%**	**Travelling to Work 6% School 0,5%**
Netherlands	49,5%	20%	24%	6,5%

SAFETY Figures:

Table IIX Fatalities and injured pedestrians

2006	Pedestrian Fatalities	Pedestrian Fatalities per million inhabitant	Injured Pedestrian	Injured pedestrian per million inhabitant
AT	110	13	4033	488
BE	122	12	4611	439
CZ	202	20	3725	363
EE	61	45	616	458
FI	49	9	601	114
FR	535	9	13609	216
DE	711	9	33226	403
HE	267	24	2756	248
HU	296	29	3640*	361
IL	139	20	3090	434
IT	758	13	21062	359
NL	66	4	1692	104
NO	35	8	867	187
PL	1756*	46*	6363	167
PT	156	15	6229	589
ES	613	14	11153	255
SE	55	6	1631	180
CH	76	10	2454	329
UK	675	11	30307	502

Though we do not know very accurately the figures of pedestrian mobility, as it is noticeable in the former paragraph, it is certain that their safety is a big worry, mostly in towns, but also in their movements out of the urban environment. The number of fatalities and injuries caused to pedestrians is extremely important. Table IIX shows that information.

The set of factors considered as the main causes of accidents involving pedestrians are the speed of motorised vehicles, the weight and design of motor vehicles, the lack of protection for pedestrians, their visibility and vehicle control and the alcohol/other drugs consumption[1]. Pedestrians, however, also have an important role to play in their own safety. Not making proper use of pedestrian crossings, crossing the road at a red light or being absentminded while using their mobile-phone or other technological devices, are common causes of accidents.

1.3. Crossing Roads Safety Norms

The contents of this section are taken from the 2008 edition of the *Pedestrian Crossings Survey* by *EuroTest*.

All countries have standards related to the planning and design of pedestrian crossings. In some countries, these national standards may be supplemented by regional standards. There is diversity in laws and guiding principles. However, one principle remains and is clearly specified in all countries: the driver is asked to pay special attention when approaching a pedestrian crossing and he has to give right of way to pedestrians. It's not only the action of using a pedestrian crossing which gives right of way, but also the evident intention from the pedestrian to cross the road. However, this last point is not clearly mentioned in the Italian legislation, for example. Furthermore, in Belgium, we can underline that the way of using pedestrian crossing is not specifically mentioned to the pedestrian. In the Netherlands, for instance, the pedestrian is not specifically asked to pay attention before using a pedestrian crossing. In Finland, the right of way of pedestrians is not mentioned in the regulation for pedestrians but only in the regulation for drivers. In Spain, the traffic law indicates pedestrians how to proceed when using the pedestrian crossing or how and where to cross when there is not a pedestrian crossing, as well as how to walk along the roads out of towns.

Regarding the material that can be used on pedestrian crossings, the use of light reflective material for stripes is mandatory in Austria, Germany, Norway and Switzerland, recommended in Finland, Great Britain, Italy, Belgium and the Netherlands and only partly specified in Spain. The use of highly skid resistant material is mandatory in Germany and Norway, recommended in Belgium, Great Britain, Switzerland, and the Netherlands and not clearly specified in Austria, Spain, Finland and Italy.

Pedestrian crossings must be safe places for pedestrians and they must be fully integrated into the urban and rural mobility network. However, to reach a good level of safety, pedestrians must also behave according to the norms, but there is not information on the observance of rules by pedestrians, as normally it is not enforced.

[1] In Spain there is information on the percentage of dead drivers and pedestrians that were under the influence of alcohol or other drugs

2. What is unknown, but should be known.

In order to be able to determine the casualty rate for pedestrians, exposure data are needed. In all cases, but especially in relation to the most vulnerable groups of pedestrians (5 to11 years old children and elderly people of 75 years and older) information is needed on their movements, motives and other influential factors, the same way that information on car drivers is obtained in actual mobility surveys. With regard to safety statistical data, additional research is needed to fill the gaps.

Based on the different countries reports it can be concluded that the amount (as well as type) of information that is collected on pedestrians varies strongly between countries. In general, data on pedestrian exposure and safety is quite poor in the European context. The problems of many pedestrian accident reports are:

- the incompleteness of data
- under-reporting of problems
- incorrect information
- extreme difficulty of integrating accident files with other relevant data files (driver, vehicle, medical, traffic, etc.) (see also PQN Short Term Scientific Mission, 2008).

To gain more insight and knowledge on pedestrians' needs and preferences it is important to develop high quality universal standards concerning pedestrian behaviour research. Besides the need for the collection of more data, universal standardized methods would make it possible to compare situations between countries. In order to compare and integrate data, a common terminology regarding pedestrian issues should also be developed and accepted. These measures will provide a huge amount of informative data and only then will it be possible to exchange information and to learn from the best practices.

Useful data do not only concern pedestrian behaviour itself (exposure rates, accident rates) but also the locations at which the behaviour takes place. When characteristics of locations are accurately registered it is possible to relate pedestrian behaviour to environmental factors and to compare situations between countries. Eventually this could lead to specific situation-related recommendations. For example, in 2001 the Technical University of Delft (The Netherlands) developed a pedestrian-comfort guideline. Formulated recommendations are dependent on the specific location. For example, it states that streets with 5.000 pedestrians over a period of 24 hrs should have at least 2 meters of free pavement at both sides of the streets. Moreover, it is recommended that the pavement width should not only be dependent on the number of pedestrians, but also on the type of street, the pedestrian behaviour at that location (playing, shopping, strolling, etc.) and the preferred quality and comfort of the pedestrians. However, if exposure data and/or accident data are known, the situational characteristics are often unknown. Another important point is that pedestrian research should not be conducted in isolation. Behaviour of other road users should be taken into account to assess the safety and comfort of a specific location. For example, if a pavement of 2 meters is recommended, but people park their car partly on the pavement, the situation will still be uncomfortable for pedestrians. Therefore, the interaction with other road users should be taken into account when evaluating the pedestrian situation. On the other hand, not only behaviour, but also pedestrian attitudes, opinions, social values and knowledge, play an important role influencing their decisions whether to walk or not.

Nevertheless, different aspects of pedestrian variables may require different methods of measurement.

Due to the regular differences between countries (and even within countries) in regard to the research methods they apply the lessons learned are currently limited. If similar research methods were applied within and between EU countries, it could be easier to compare different variables and clear and suitable recommendations could be developed for the adjustment of environmental design. Whereas attitudes, needs, and preferences can be measured by surveys, actual behaviour on a specific location should be monitored by cameras (by using a GIS system). While exposure data can be collected in a fairly objective way, accident data are far more affected by subjective interpretation and incompleteness. Especially in the case of accident data, standardized measures and inter-observer reliability is required, which can be partly provided by recording with camera systems.

3. Conclusion - Recommendations

Completeness and Definitions of data

There were a number of issues related to the completeness of data; they are not equally defined by the different sources, so their concretion is sometimes compromised. Tables are used in different ways (and for different purposes) in different countries, and are also explained differently by placing emphasis on different features. Therefore, in a continental study such as this, it is necessary to translate them from local uses, in order to provide a global perspective.

A first pedestrians´ safety need is a good and complete data-base, made using European standards. Pedestrian conditions will not be improved as much as needed if the concerned information is not collected and analysed with standardised methods that allow comparisons between countries. To define standards for this kind of measures and data would be of great help for global studies like this.

It is also very important to address the modal shift. The modal shift is strictly related to different characteristics of cities. The blend of lower speed and a better mix of modes became an important factor in improving safety for pedestrians (Fleury, 2002; ETSC, 2005b).

Another important issue is the need for specific studies into pedestrian beliefs, interests and behaviours related to specific circumstances. There are very different attitudes towards urban space from pedestrian, on one hand, and car drivers on the other, even when they are the same people.

Best practises should include the study of all these aspects.

Campaigns have an important role to play in achieving increased awareness about risks for the most vulnerable road user and also in increasing understanding and acceptance of the need of measures to facilitate their mobility and safety.

Other examples of good practises are: the design of school guides and children circuits to show how to travel in public spaces or an innovative way of measuring pedestrian behaviour, the Spatial Metro Project (Van der Spek, 2006). This project aims to develop new ways to gain insight in pedestrian behaviour. Three different measures are used: GPS, Video observation and questionnaires. GPS data can provide detailed information on activity patterns and spatial-temporal navigation patterns. This could lead to better environmental design for pedestrians.

Some research projects have been developed keeping elderly people in mind, for example changing traffic light periods (giving more time to cross the streets) if there is someone in the zebra-crossing.

More examples can be obtained from: (TEC, 2007), (Fleury, 2002), (ETSC,2005b), Action COST C6.

References

ADONIS (1998) *Transport Research Fourth Framework Programme Road Transport VII - 56 : analysis and development of new insight into substitution of short car trips ADONIS by cycling and walking : how to substitute short car trips by cycling and walking*. Office for Official Publications of the European Communities Eur-OP, Luxembourg.

Bassett, D., Pucher,J., Buehler, R., Thompson,D.L., Crouter, S.E. (2008). *Walking, Cycling, and Obesity Rates in Europe, North America, and Australia.* Journal of Physical Activity and Health, Vol. 5 pp. 795-814

Cabello, E., (2006).*Computer Vision Technologies and Traffic Safety.* Seminar Video in Traffic: video analysis in traffic applications. May.

Dell' Asin, G., (2008), *Short Term Scientific Mission*. Report

ETSC (2005). *The safety of vulnerable road users in the Southern, Eastern, and Central European countries (The "SEC Belt")*. European Transport Safety Council ETSC, Brussels.

ETSC (2005). ETSC YEARBOOK 2005: Safety and Sustainability. European Transport Safety Council ETSC, Brussels. ISBN: 90-76024-19-7

Fleury D. (2002) *A city for pedestrians: Policy making and implementation. A propos du rapport de l'action COST C6 = A city for pedestrians : Policy making and implementation. Concerning the COST action C6 report. Institut national de recherche sur les transports et leur sécurité,* Arcueil, FRANCE (1986) (Revue) INRETS, Arcueil, FRANCE

Fuente, L.A., (2007), *Passenger Mobility in Europe. Statistics in Focus.* Statistics in Focus. Eurostat. Catalogue Number: KS-SF-07-087-EN-N

Fuente, L.A. (2005), *Short Distance Passenger Mobility in Europe*. Statistics in Focus. Eurostat. Catalogue Number: KS-NZ-05-005-EN-N

Laureshyn, A., Ardö, H., Svensson, Å., Jonsson, T., (2009) *Application of automated video analysis for behavioural studies: concept and experience*. IET Intelligent Transport Systems

TEC (2007). *Those feet were made for walking*. Traffic engineering & control 2007, vol. 48, no4. ISSN 0041-0683

OECD (1998) *Safety of vulnerable road users*, Organisation for Economic Co-operation and Development OECD, Paris.

Van der Horst, R.A., (1990). *A time-based analysis of road user behaviour in normal and critical encounters.* Ph.D. Thesis, Technische Universiteit Delft.

Van der Spek, S.C. (2006*). Legible city – Walkable city – Liveable city*. Observation of walking patterns in city centres. http://urbanism.nl.

Victoria Transport Policy Institute, (2009). *TDM Encyclopedia.* Transportation Statistics. Transportation Information Sources. http://www.vtpi.org/tdm/tdm80.htm

RACC, (2008). *Anuario de la Movilidad*. http://www.racc.es

Some web pages of interest:

ADD HOME. *Add Home: Mobility management for housing areas – from car dependency to free choice* - ongoing http://www.add-home.eu

CIVITAS. *Fact sheets from various projects on sustainable, clean and energy efficient urban transport systems by implementing and evaluating an ambitious, integrated set of technology and policy based measures* - ongoing http://www.civitas-initiative.org/

COMPETENCES. Competences t*rengthening the knowledge of local management agencies in the transport field (2007)* http://www.transportlearning.net

CULTURA. *Cultura for a new mobility through mobility management, awareness measures and campaigns for changing mobility behaviour. (2005)* - ongoing http://www.mobility-cultura.net

E-ATOMIUM. *Transport and mobility training for energy agencies and local actors (2007)* –ongoing http://www.e-atomium.org/

ELTIS. *Interactive Guide to current measures* – ongoing http://www.eltis.org

EMOTIONS. *Emotions for clean urban transport* – Final report (2004) http://www.emotional-campaigns.net/

GOAL. *GOAL – Healthy without car and noise* – Final Report (2003) www.goal-graz.at

MOST. *Mobility Management Strategies for the Next Decades* – Final Report (2003) http://mo.st

MOVE *International Cluster for Mobility Management Development and Research Dissemination* ongoing - http://www.move-project.org/

STEP BY STEP. *Awareness for clean urban transport* – Final Report and fact sheets (2005) http://www.eu-stepbystep.net/

TREATISE. *Training programme for local energy agencies and actors in transport and sustainable energy actions (2007)* http://www.treatise.eu.com/

VIANOVA. *Healthy mobility and intelligent intermodality in Alpine areas* – ongoing http://www.eu-vianova.net

EPOMM. *European Platform on Mobility Management* –ongoing http://www.epommweb.org