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# ICTCT

International Cooperation on Theories and Concepts in Traffic safety

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**PROCEEDINGS OF THE  
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"PEDESTRIAN  
PROBLEMS"**

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## ***Abstract***

This report summarises the results of ICTCT 's workshop held in Prague in October 1994, dealing with the situation of pedestrians in to-day's traffic. From this huge area, some central topics were chosen and dealt with in working groups: \*) Sociological aspects (road user groups and their power, influence on city planning and on all kinds of measures taken or not taken, and "history" of interaction between different road user groups), \*) Aspects of problem locations (cities, third world countries, residential areas different types/categories of places and road sections where there are pedestrians), \*) Problem types and their appearance (life quality problems including mobility, space consumption, aesthetics, safety; modal choice; individual problems depending on the group one belongs to) and \*) Questions connected to problem analysis and evaluation (both "broad evaluation" in the sense of many evaluation types on the micro level, and social and socio-economic evaluation on higher level). All problems and aspects were dealt with from the macro, meso and micro-perspective. All materials and arguments that were in some way connected to countermeasures were to be **marked** and **summarised**. Evaluation methods and recommendations were discussed in the plenum.

As a result, policy goals that are considered as most important by ICTCT were listed (\* car speeds have to be controlled better than they are today, it is advisable to improve the quality of life in the society by improving that of pedestrians, \* those people who have no other possibilities than to walk should have *sufficient mobility so that they can maintain their social networks*, and participate in their normal activities without any needs for special solutions, \* the subjective safety of vulnerable road users should be at least on the same level as that of car drivers and passengers, \* it is absolutely necessary to *improve pedestrians' general role in transport policies, planning, engineering, product design, etc.* This would ensure in the long run that the safety and mobility requirements of pedestrians are fulfilled). Recommendations for both future research and evaluation work and aspects to be stressed in future co-operation with practitioners and authorities were formulated.



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## *1 Introduction*

We are in the paradox situation in Europe, that on the one hand car traffic is experienced as a nuisance in many cases - even, and sometimes most of all, by authorities - and, e.g., projects are carried out with the goal to transfer short car trips to walking and cycling<sup>1</sup>. On the other hand, the risk of getting involved in an accident as a pedestrian - and to get severely hurt or even killed in such an accident - is considerable.

It is very easy to agree that walking (more) instead of using the car all the time is a goal that should be supported by society, for many reasons: Environmental reasons, economical reasons (e.g., city centres with low car concentration are economically better off), esthetic reasons (lower portions or lack of car traffic allow different architectural solutions), etc. It has to be added that there are many people who have no other possibility to be mobile than by walking. But how should society take the responsibility to convince people to walk (more), if walking is not safe enough.

Moreover, from what is known today it can be stated that not only safety is lacking: From the (potential) user perspective, many other preconditions are not good enough for a clear change of habits towards more walking. Lack of comfort (e.g., high curbs, cars parking at the corners and disturbing the crossing of side roads, narrow pavements), long waiting times (signalised crossings) and unnecessary long distances (feelings that pedestrians in spite of being the most distance-sensitive road users are very often lead long ways), the noise and the bad air produced by the cars have been listed as the most important negative incentives in a study by Praschl et al. (1994) The interesting thing is that safety problems are only felt as being relevant for others: People are afraid for the safety of their beloved ones, their children, etc.. The most important exception, though, are elderly people, many of whom really do reduce their mobility as pedestrians because of feelings of unsafety (Chaloupka et al. 1993). But summarising - and knowing that the average individual feels that he/she has good control of most situations, even as a pedestrian, and thus does not "have to have" unpleasant feelings like that of unsafety - one can say that safety, or the lack of it, certainly is a factor that influences modal choice.

### *1.1 Are solutions considering user interests necessary?*

How would potential users like the situation to be? Too little is known about needs and interests of different road user groups. Authorities tend to talk of "requirements" in an absolute meaning<sup>2</sup>, as if "requirement" could be interpreted in an other way than with respect to certain groups needs

1

In the 4th Framework Program, the EU-DG VII is financing work with the goal to be better able to transfer short car trips to walking and cycling. One of the projects that will be supported is WALKING - Walking and cycling instead of short car trips. This project will be co-ordinated by Christer Hydén, the present chairman of ICTCT

2

E.g., "there are no pedestrians there, anyway, so infrastructures that fit the needs of pedestrians are not required", as if pedestrians would be "there" totally independent from infrastructures

and interests. In reality, different groups' needs and interests, conflicting needs and interests within and between groups, and the way in which interest and needs of different groups are effected when certain measures are introduced - or when they are not - are hardly ever analysed well enough.

*Rut when cooperation of people is needed<sup>3</sup> - e.g., when one wants more people to walk instead of using the car for short trips - this request will be reacted to in a satisfying way only if walking is considered attractive by the public, i. e., when certain needs and interests of the public (or parts of it) are fulfilled.*

In traffic, the traditional way to consider people's (road users') needs is to assume what they want and what they need. One would almost say that authorities take care of the people's interest in the social-democratic style. However, the discussion in the media gives the impression that during the last years more and more people want to express their interests themselves and do not want to be interpreted too much.

Instead of assuming what road users want and what they need, it is suggested that different groups of road users (of people) are dealt with in a psychologically and social-scientifically correct way that makes sure that different groups of people's needs, motives, interests and attitudes are reflected/interpreted more thoroughly. Only then can both technically<sup>4</sup> and politically<sup>5</sup> correct decisions be taken.

### *1.2 Conflicting interests*

When trying to resolve the difficult task of considering different road user groups' interests in a satisfying manner, one meets, among other things the two following problems:

more or less legitimate, but conflicting interests of different groups (e.g., traffic calming measures reduce comfort of car drivers, but improve both comfort and safety of elderly road users)

conflicting interests within groups (e.g., people want traffic calming measures where their own children play, but often feel disturbed by them on other sections of the road network)

3

We want to remind the reader that in road traffic there are hardly any measures where the cooperation of road users is not needed at all

4

All measures that rely on or aim at behaviour changes of people (road users) - and virtually all technical measures are of this type - need the cooperation of the people (road users), otherwise they will not work in the wanted way

5

If decisions do not refer clearly to people's or at least to certain groups of people's needs and interests, there will be the suspicion that politicians follow their own interests, or that they support interest of certain subgroups in a hidden way

Political decisions should rely on thorough analyses of different groups needs, motives and interests; then, responsibility has to be taken and conflicting interests have to be weighed against each other clearly and transparently. A public discussion should always be possible; in case such a weighing is difficult, public discussion should even be enhanced, because it would provide more materials for decision taking.

One interesting point is that it is not at all impossible to set priorities between different types of needs and interests: E.g., physical safety of the citizens is placed very prominently in the law texts, while the comfort of people is never named directly and should have lower priority in case of conflicting interests. On the other hand, comfort is strived for by all people and it will play an important role in marketing of, e.g., different ways of transport, which will cause other clashes of interest that have to be solved.

*An example:* The comfort of car drivers, e.g., on roads in the city where they can proceed quickly and undisturbedly, might be in conflict with the safety of pedestrians (e.g., if there is a certain potential of pedestrians, if the road in question is no motorway, and if some of the people - or what is worse: their children - have to walk along this road or to cross it). Safety should win, in this case. To allow this, a pedestrian bridge over the road is built.

Let us assume that three things happen at the same time, now, as a consequence of this measure: a) the number of pedestrians in total is reduced, b) some pedestrians do not use the bridge and still cross the road on the surface and c) some people write to the authorities complaining that having to cross a bridge is a very uncomfortable thing for them.

Let us assume, moreover, that another possible solution would be, to reduce car speeds instead of building a bridge. Any representative of car drivers could say, in this case: There is the possibility of building a bridge, but pedestrians deny that of comfort reasons. So this is a question of comfort for group A vs. comfort of group B, and not a question of comfort vs. safety.

One can accept this argument. But in this case, authorities have to come back to their original goal: If the increase of car traffic really should decelerate, there have to be more and more cases like the one just exemplified, where it is decided in favour of the pedestrians. **Deciding in favour of the car drivers makes using the car more attractive, deciding in favour of the pedestrians makes walking more attractive.**

Many conclusions can be drawn from this example. The most important ones we like to draw here are the following:

1. Safety influences the attractiveness of walking, but
2. safety is only one of several factors influencing the attractiveness of walking, and
3. safety can be achieved by different means

### *1.3 What are these proceedings about?*

In these proceedings, most weight will be put on pedestrian safety problems. But in all sections we look at safety problems as an integral part of *pedestrian problems in general*, that influence the decision if one should walk or not. It will be discussed where and how they appear (sections 2 and 3), and how they can, or should, be registered and operationalised (section 4). In section four, even some hints on how to solve safety problems will be given. But to start with, we want to discuss and specify a little more where to place “safety” in the frame of all the factors influencing the situation of the pedestrian and the attractiveness of walking (section 1).

## *2 Identification of pedestrian<sup>6</sup> problems<sup>7</sup>*

The pressure of technology development in transport enhances establishing of dynamical processes of high complexity in the public space, especially in the cities. This would suggest that complex planning structures are developed in order to find solutions that correspond to the situation.

Planning of towns and transport in the traditional way, however, always was characterised by a juxtaposition of monofunctional solutions. At the same time, public space was looked upon as a physical space instead of as a social space. Thus, technical solutions were and are highly estimated. In this frame, the interests and interest groups around “the ear” were most influential.

According to the authors of these proceedings, two problems can be selected that both result from this type of planning and that are relevant in connection with the area we deal with here; the situation of pedestrians. These two problems are that

- a) Safety of pedestrians is not sufficient and
- b) that life quality of inhabitants of towns and cities is not sufficient

These problems are intimately related to each other; (short) walks belong to living in the city. At the same time, we assume that making walking safer would lead to a number of other changes in traffic that improve life quality (less noise due to fewer cars and reduced speed, optical changes due to changed lay-outs of crossings etc., fewer cars parked in the public space, etc.).

### *2.1 The situation of pedestrians*

The situation of people who walk (who want to walk or have to walk) can shortly be characterised as follows:

#### *2.1.1 Pedestrians have no power on a macro level*

Many facts and assumptions in the field of transport sciences lead us to this conclusion. The following three aspects reflect the statement in the headline above in a comprehensive way:

1. typical groups are politically inactive (children, youngsters) or active at a reduced level (elderly people)
2. average people with no drivers licence or with no ear are usually socially less powerful (poor, disabled, immigrants, alcoholists)
3. all people who only walk now and then and otherwise have the possibility to use the ear tend to focus on ear drivers’ problems

6

In this connection, the concept of a “pedestrian” is fictitious: It is suggested that a pedestrian is a person who does most of his/her everyday trips by walking, and who uses public transport, or the ear, only for journeys that cannot be done by walking (the limit for which is varying, depending on the person involved, on the circumstances, on the physical and infrastructural preconditions, etc

7

This chapter is based on the summary of the working group on “Identification of pedestrians problems” by R. Risser. Dominique Fleury, Gösta Gynnerstedt, Ralf Risser and Josef Steinbauer took part in this working group

From a sociological perspective it is concluded that these aspects make that not so many efforts are made a priori to help this road user group.

### 2.1.2 Sometimes pedestrians have (and exert) power on a meso level

Where interests as residents, as parents, as pedestrians on the way to their parking lot, or to the nearest bus station, or to the nearest shop, overlap, you can find pressure groups in the cities and towns, but most of all in the outskirts of the cities who defend “pedestrian rights”. In these cases the “resident” part even of ear drivers becomes so strong that the intrapersonal conflict of interests (between the “ear driver me” and the “resident me” is solved to the advantage of the resident).

This is a very new aspect. Lots of materials on the topic are still to be collected. It will be interesting to see how people fight for certain goals when they will be affected as, e.g., residents themselves, compared to their attitudes towards certain measures they have as ear drivers.

### 2.1.3 People who walk have rather limited power on a micro level

People who walk have severe disadvantages in their interaction with other road user groups (especially with ear drivers)

- 1 physics would predict that for the case of a collision
- 2 accident analyses give clear hints in this respect (to insist on one’s rights has obviously totally different implications for pedestrians and for ear drivers)
- 3 behaviour/interaction observations show it

Almost naturally, research concentrated on the “risk emanators”, and not so much on those who feel risk most immediately - i.e., unprotected road users. However, interestingly enough, in the few cases when research deals with pedestrian problems, it is more usual to talk about the mistakes of pedestrians than of their needs.

Having said all this, and concentrating on pedestrian problems, especially with respect to safety, one wants to suggest to

- concentrate on pedestrian needs
- define different groups of pedestrians (based on empirical social data; e.g., include the concept of “residents”), in order to be able to discriminate between different types of needs
- define criteria for “good” traffic with thorough consideration of the needs and interests of different road user groups, and give pedestrian and residents’ interests an adequate weight
- define the role of safety in the traffic society, and how it can be achieved, also with respect to the needs of pedestrians (including “residents”)

Those, who concentrate on transport from an economical perspective (underlining how important transport is for an industrial or even post-industrial - society should remember, that walking is transport.

## 2.2 Walking

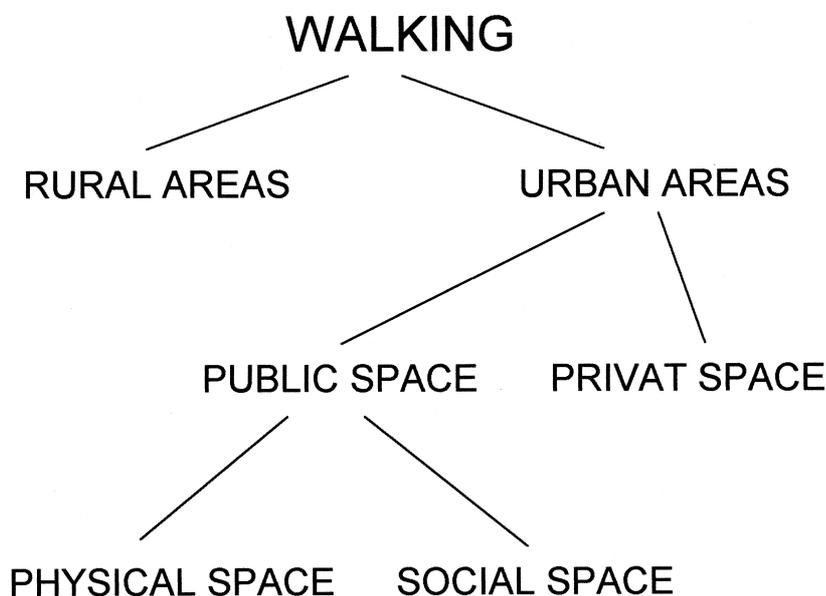
In traffic and transport, research on walking is not very frequent and a rather new topic (although it is the oldest way of transport). Obviously, researchers implicitly did not consider walking as a way of transport. Maybe, unreflectedly, they started from the assumption that “people” make all possible efforts to avoid walking more than necessary, and maybe they forgot other important aspects:

a) only very few people have the possibility to travel all the way in, e.g., their car without having to walk at least for a short period in the public space

b) there always existed and there exist also today people whose only possibility to travel is to walk (References: Garbrecht 1981, Olof Gunnarsson, etc.), e.g.

- old people who cannot drive a car any longer, and especially so when they have nobody to take them to places
- children and youngsters (only to be outside when one is transported by car by, e.g., the parents, would really mean to be locked in)
- poor people who cannot afford a car (on average, they have to walk for longer ways than car drivers even where they have public transport means they can use)

Graph 1: The walking space



## A functional definition of “walking” and the walking space

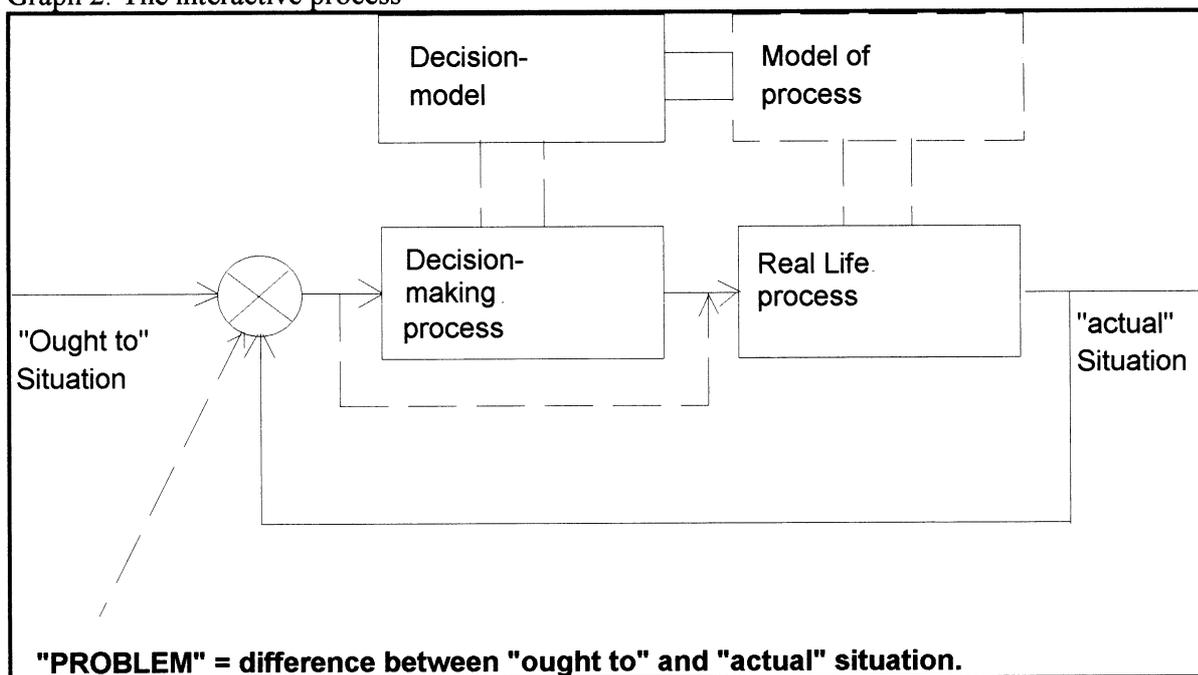
We have decided that we want to look at walking in the public space of urban areas and that we will look upon this public space as a social space (see graph 1). The alternatives that can be derived from graph 1 are either less relevant (like walking in rural areas, which is far from being uninteresting, however), not or only rather marginally belonging to our sector “traffic and transport” (like walking in the private space), or much too restricted in their perspective and thus enhancing monofunctional solutions (like looking upon public space as a physical space).

In the case of playing children, one should have an extra look on what grey zone there is at the border between private and public space.

### *2.3 How to improve the preconditions for walking*

When we say that there are “problems” connected to walking conditions in our present traffic network, we obviously talk about a situation as it ought to be and refer to the difference of this “ought-to-be” situation to the actual situation. Graph 2 displays this.

Graph 2: The interactive process



How should this graph be read? The line followed by G. Gynnerstedt (the author of graph 2), was the following:

- 1 An actual situation is compared to the “ought-to-be” situation and the result of this comparison is “the problem”

- 2 The situation develops further as soon as anybody realises or feels that there is a problem; this can happen on the decision level (including the so called decision makers), but also in more “analogous” ways (meaning that involved people do not treat the problem consciously but adapt on the reflex-level).
- 3 Anyway, the real life processes that result from the stated or experienced differences between an ought-to-be situation and the actual situation, can be different from what they were before any problem-identification process (and they will most probably be different if it is tried explicitly by anybody to improve the actual situation).
- 4 What are needed in order to understand changes, and as a precondition to changing things on purpose, are both models of such decisions (“digital” and “analogous” ones) and models of the real life processes; one needs reliable models of these processes in order to be able to assess and/or influence them.

More concretely, in our case we would take the steps as outlined in graph 3. There the “ought-to-be” situation is defined with reference to the different needs of different (groups of) people who have to or want to walk today, but even the needs and interests of those who would be prepared to walk more under different conditions.

Graph 3 suggests the planning of traffic according to the needs and interests of different groups and subgroups of road-users and residents on all levels<sup>8</sup>. Conflicting needs and interests have to be made transparent. If somebody states that it is a political act to decide which interests are to be respected best, then, we do not discuss this here. All we say in this part of the minutes of a group work is that there are legitimate pedestrian interests that are frequently neglected according to our interpretation. They should be considered in planning, and evaluation processes should build on these considerations.

Steps one to three in graph 3 will provide know-how about different pedestrian groups’ needs and, thus, about the nature of different decision processes (e.g., motivational background for modal choice). This will allow, to make walking “a pleasure”. if anybody wants to do so.

But also, any decision to influence modal choice in the direction of walking will have a better chance to be transformed into successful measures if the background for modal-choice decision is known.

8

See Risser R., “Criteria for ‘good’ traffic”, in the appendix of this report, as well

- 1. GROUPS AND THEIR NEEDS**
- 2. PROCESSES ACCORDING TO THIS  
(OUR CRITERIA OF PROBLEM  
DESCRIPTION)**
- 3. FOLLOW UP AND EVALUATION**
- 4. IMPROVE KNOW-HOW ABOUT  
DECISION PROCESSES  
(IN HEADS AND IN GROUPS)**
- 5. INPUT ACCORDING TO DECISION  
PROC**

#### *2.4 How to consider interests*

It was said above that we do not appreciate monofunctional solutions. Thus, different functions should be considered already in the analytic phase. In this paper, we want to present a model of what should be considered in connection with need analysis (graph 4).

It almost goes without saying that people will have fewer difficulties to agree on values to be respected, on a higher level of the discussion. Everybody agrees on the relevance of the values themselves, and nobody says (loudly) that they should not be considered. However, operationalisation, implementation, and evaluation are increasingly more difficult to be achieved in agreement. Several types of conflicts are to be expected. The graph above symbolises the three most relevant levels of conflicts; intrapersonal ones, interpersonal ones, and conflicts between individuals and the society. These three types of conflicts reflect much of what has been said above already.

##### *2.4.1 Intrapersonal conflicts*

We have said above that the role of ear-driver is prioritised by those people who drive a car frequently. Without much reflection, they will vote for the interests of car drivers to be considered firstly. However, marketing measures could make use of the fact that “there is a little pedestrian in every car-driver” (see what has been said about the “meso-level” at the beginning of these minutes)

Graph 4: From values to action

## **VALUES AGREED UPON**

EQUAL RIGHTS  
PROTECTION AND INTEGRITY  
OF HUMAN LIFE  
FREEDOM (OF CHOICE,  
OF DECISION)  
ENVIRONMENTAL PROTECTION, et.

## **OPERATIONALISATION**

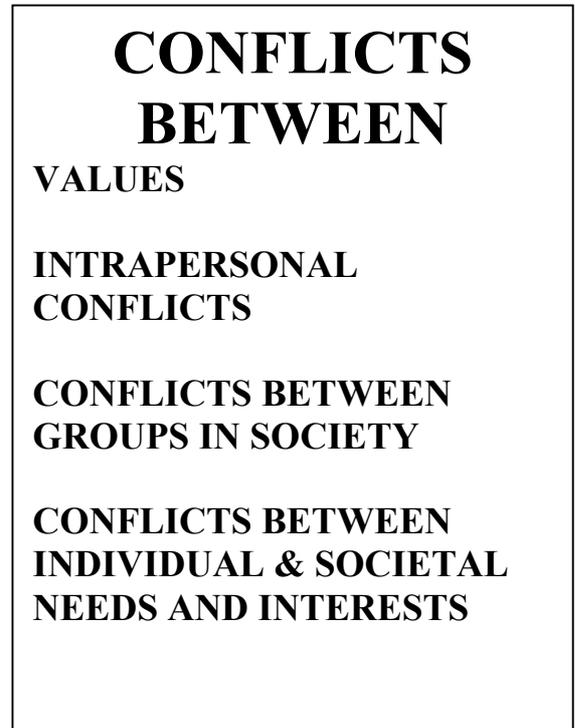
HOW ARE THESE VALUES  
REFLECTED AND DEFINED  
MORE IN DETAIL?

## **IMPLEMENTATION**

WHAT DO YOU HAVE TO DO?  
HOW DO YOU HAVE TO  
BEHAVE IN ORDER TO  
ACHIEVE THESE VALUES?

## **EVALUATION**

IS VALUE ACHIEVED??



### 2.4.2 Interpersonal conflicts

Conflicts between (groups of) different individuals in traffic are the most logical outcome of the fact that different (groups of) individuals in traffic (road users and residents) feel different needs and have different interests in several respects. (However, one could also say that they have similar or even the same needs, but the fulfilment of the needs of one group frequently calls for measures that have unwanted consequences for other groups). As a layman in jurisprudence one would say that it should be seen to it on legislation level that the legitimate needs of pedestrians are respected (this becomes most clear when one remembers that there is a considerable number of people who have no other possibility to be mobile than walking).

But even with respect to marketing of walking the argument made in connection with intrapersonal conflicts is valid; ear drivers do know the pedestrian perspective, and it is probably a question of “selling” measures, if better conditions for walking are accepted by the ear driving groups.

In the following, an example for a “typical” conflict between interests of different groups is given (in this case between bus drivers and pedestrians). At the ICTCT workshop in Salzburg 1993, Kirsi Pajunen (1994) showed us, that according to statistics, buses represent a very safe transport mode. However, in the discussion of her presentation colleagues came to the conclusion that there is an interest conflict between buses (or bus drivers) and pedestrians.

Graph 5 (below) reflects this conflict that was felt to be rather typical for cities. Pedestrians in Vienna (Praschl et al. 1994) would state, that bus drivers are the most ruthless people they know. Now, it would be really arrogant to tell pedestrians that buses are safe, objectively, and thus pedestrians have to swallow the behaviour of bus drivers.

There is one more aspect to this that can be mentioned here (as implicitly we have discussed walking as something that should increase compared to ear driving - remember all “marketing” arguments): The comfort felt in connection with a certain modal choice is the product of a large number of factors. Ruthless bus drivers are certainly a strong argument against walking, if a road with bus traffic has to be crossed or if any other interactions with bus drivers become necessary.

Graph 5: A conflict between the interests of ear drivers and those of pedestrians

	<b>SAFETY</b>		<b>EQUAL RIGHTS</b>	
	<b>BUS +DRIVER</b>	<b>PEDESTRI-ANS</b>	<b>BUS +DRIVER</b>	<b>PEDESTRI-ANS</b>
<b>VALUES</b>	OK	OK	OK	OK
<b>DEFINITION/ OPERATIONALISATION</b>	NO ACCI-DENTS	NO ACCI-DENTS	AGREEABLE MOBILITY	AGREEABLE MOBILITY
<b>IMPLEMENTATION (OR JUST “AS THINGS HAVE DEVELOPED”)</b>	= STATUS QUO IN THIS CASE			
<b>EVALUTION (ACHIEVED?)</b>	YES	YES	YES	NO

Risser (in ICTCT 1994) has discussed extensively, how this interest conflict should be tackled, namely mainly by reducing the speed of buses in a smooth way, in areas where they have to interact with pedestrians. As long as speed remains constant, passengers in buses do not react strongly against reduced bus speeds.

#### 2.4.3 Conflicts between individuals and the society

Very often road users want to behave in a way that is detrimental for safety in a statistical sense. Obviously, they do not feel any risk (or feel that risk is under control) when they do so. However, countrywide, this behaviour leads to considerable safety problems. A risk of this type is very

abstract and not felt. Consequences are not anticipated by the individuals. (Psychology tells us that such consequences are no good reinforcements).

Behaviour of ear drivers when turning left or right in the cities, and by that crossing the ways of pedestrians who walk straight on, can be seen under this perspective (and a lot of other types of behaviour, as well): It is obviously dangerous to force one's way through groups of walking pedestrians in such situations, or to turn left or right without considerable deceleration (e.g., if one does not see any pedestrians as a driver), as accident statistics from big cities show. And, obviously as well, ear drivers do not feel such danger. (Of course, this conflict can also be seen as a conflict between (groups of) individuals, as pedestrians heavily criticise the behaviour of ear drivers in such situations, see, e.g., Garbrecht 1981).

### *2.5 How can interest conflicts be solved?*

The working group came to the following conclusions that refer more to the methods of data collection and interpretation than to giving advice for conflict-solution processes from the shelf

1 Prepare better materials, especially with respect to establishment of groups and subgroups who are affected by different situations (to be evaluated) or by different measures (e.g., elderly, children, parents, "average" ear drivers, professional drivers, cyclists). Produce thorough description and specification of their needs and interests, in order to provide for a good basis for problem solutions (so that, e.g., "political" statements like "ear drivers never would accept such a solution", become obsolete).

2 Even, if this is not the case for the recommendations you are reading here, it has to be remembered that recommendations have to be operational in the sense of **what should be done** and **why should it be done**, where one again should refer to all relevant groups and subgroups. E.g., to recommend road-narrowings at crossroads in the city so that crossing distances for pedestrians become shorter, is not enough; it has to be added that these measures are most often implemented in a way - together with other measures - that they also lead to lower ear speeds, that they prevent cars from parking at the corners, etc.. Thus, the measure has more advantages for one group, and more disadvantages for the other group. Suddenly it becomes clear that one has to look at the character of advantages and disadvantages: For pedestrians it seems to be a matter of safety if their crossing distance becomes shorter and if ears drive slower, for the ear drivers it is more a matter of comfort and not so much of vital needs.

3 Thus, it has to be seen to it that one gets data from different disciplines, or that one gets allies from different disciplines: If the task to "make walking in the cities more worthwhile" has to be fulfilled, a large number of experts from different disciplines should be involved in such a task architects, psychologists, road construction engineers, sociologists, town planners, traffic engineers, and others.

### 3 Problem location<sup>9</sup>

#### 3.1 Safety and other important things

Pedestrian safety and especially child pedestrian safety has improved in France, Japan, and the Nordic countries considerably since the early 1970's. Pedestrians still have, however, numerous safety problems in the transport system of today.

##### 3.1.1 The safety problem

We discussed and identified several different **problems** related to pedestrian safety. *The first* is related to measuring pedestrian *safety* i.e. what is the right indicator for that purpose? Several different ratios have been used, e.g.

1 number of accidents resulting in pedestrian injuries / exposure

2 number of accidents resulting in pedestrian fatality / exposure

3 number of pedestrian fatalities/number of pedestrian injuries

The number of fatalities has the advantage of almost 100 % reporting by the police, and a very common definition of the person dying within 30 days of the accidents (although e.g. in France the time limit is 6 days, and in Japan as short as 24 hours). The disadvantage of fatalities is their large random variation due to the small numbers. The number of injuries is much higher and therefore it has much smaller random variation, but their underreporting is a considerable problem. The reporting varies very much between countries and also within countries, in addition to the fact that the definition of injury differs quite much. Hence, both have their advantages. It is also evident that the choice between fatalities and injuries affects safety analysis with regard to results. The paper presented by B. Cambon De Lavalette (appendix) showed that in terms of child pedestrian injuries/child population, the safety of child pedestrian becomes worse with increasing town size.

##### Town size and pedestrian accident injuries<sup>10</sup>

General aim of the paper is to identify the specific groups of young pedestrians that are at high risk to be involved in traffic accidents. The paper explores especially the relationship between young pedestrians' accident occurrence and severity and urban density (rural communities; < 5000 inh., 5000 to 20000 inh., 20000 to 50000 inh., 50000 to 100000 inh. and > 100000 inh.). Child pedestrian accident rates appear to be proportional to urbanisation density, whereas accident severity is negatively related to conurbation size: The higher the conurbation size, the lower the accident severity rate. Speed seems to be an important underlying factor. The city of Paris has an extreme position on both scales (accident and severity rate). To reduce the numbers of child accidents, the large towns need countermeasures. First fatality rates should be reduced, and then rural and semi-rural areas should be treated more in detail.

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This chapter is based on the summary of the working group on "Problem location" by R. Kulmala. Mladen Gledec, Christer Hydén, Masaki Koshi, Risto Kulmala, Brigitte Cambon de Lavalette took part in this working group

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See B. Cambon de Lavalette, "Town size and pedestrian injury accidents", In the appendix of this report

When the indicator is the number of child pedestrian fatalities/child population, the safety seems to improve with increasing town size.

The *definition of exposure* is the other aspect of the indicator problem. The ideal measure for exposure would perhaps be the number of encounters between a pedestrian and a motor vehicle, where an encounter is a situation where both participants have crossing paths, and there is a risk of their collision unless at least one of them changes his course or speed to avoid it. The number of encounters is unavailable at any statistics, and therefore a number of other exposure measures have been used, e.g., pedestrians' distance travelled, time spent in traffic, population. Some exposure measures get near to the idea of encounters by using the product of *vehicle x pedestrian* flows.

Conflict studies and other behavioural studies offer the possibility to actually count the number of encounters, and the number of conflicts, and then have the number of conflicts/ the number of encounters as the indicator of pedestrian risk.

### 3.1.2 "Other" problems

The *second problem* is related to **the other pedestrian problems in traffic**. The whole community and urban structure is very much based on the use of motor vehicles, and the use of cars in particular. This has a negative effect on the mobility of pedestrians and other vulnerable road users in general. Whereas pedestrians are often children, or elderly, these mobility impacts focus on these demographic groups especially. All of this has a negative effect on the quality of life in today's society, and especially in the urban areas.

The *third problem* that we discussed was related to the **poor adaptation of humans to new traffic systems**. One example were the safety problems encountered by the Bosnian refugees in Croatia. The people from the rural areas of Bosnia have had high accident risks in the urban areas of Zagreb. Many of the safety problems of children can be explained by their difficulties in learning to adapt to the traffic system designed to work under the conditions set by car traffic. The elderly, who have adapted their behaviour to the particular traffic system in their daily living environment, have sometimes tremendous difficulties in adapting to new traffic systems (e.g. traffic signals) in that environment. One part of the high accident risks in developing countries might also reflect this difficulty of adaptation to new transport systems.

The problems in developing countries, however, are also linked to other factors. One is the fact that the transport **mode is connected to the social position** of the person. Car owners and drivers in the developing countries have a high position in the social hierarchy, and the pedestrians lie very low in the hierarchy. This social structure is also reflected in the traffic system, in official and unofficial traffic rules, and in the outcomes of interactive situations in traffic. The pedestrians should always give way to car traffic, and the car drivers rarely pay any special attention to pedestrians.

The overall problem is the fact that car drivers set the scene for other road users. This applies to all levels, macro, meso, and micro. Above, we have mentioned some macro level examples. One example from the micro level is a highly over-speeding driver. As the car moves along the street network other drivers and especially vulnerable road users immediately have to react defensively in order to maintain their safety and health. The car drivers can force the situation in their favour by various means, and one of them is speed.

On the macro and/or meso level. the pedestrian *safety problem areas* are:

- developing countries
- big cities (accidents)
- rural communities (fatalities) low income families

On the micro level. the problem areas are:

- high-speed drivers and motor vehicle speeds in general
- central business districts of the cities
- residential streets (children)
- junctions and intersections

### *3.2 Possible policy goals*

The **primary goal is to improve the quality of life** in the society by improving that of pedestrians. This means that we should aim for improving the pedestrians'

- mobility
- safety
- feeling of safety

Pedestrians should have sufficient mobility so that they can maintain their social networks, and participate in their normal activities without any needs for special solutions. The safety of pedestrians and other vulnerable road users should be at least on the same level as car drivers and passengers. On the macro and meso level, the feeling of safety should be so low that it does not affect the pedestrians' mobility nor cause any anxiety in their part. On the micro level, a certain feeling of unsafety might be beneficial to the objective safety of pedestrians, by making them wary and attentive in risky road and street environments.

The **second goal is to improve pedestrian's general role** in transport policies, planning, engineering, product design, etc. This would ensure in the long run that the safety and mobility requirements of pedestrians are fulfilled.

### *3.3 Relations between macro meso and micro levels*

In our discussion, we reached the conclusion that micro level measures also affect the macro/meso level in general. We also found out that these effects are not always necessarily in the same direction. One example is the implementation of physical speed restriction measures on just one road section. This might result in car drivers choosing to use an alternative and even longer route to avoid the improved section, which in turn could affect an increase in the number of accidents in the whole network, while the accident number on the improved section might be dramatically reduced.

This interaction between the different levels call for a strategy of implementation. In a good strategy, the safety measures form an important link in the communication between safety experts, decision makers, traffic planners, and the road users or citizens in general. Hydén gave an illustrative example of this in the case of the Swedish town of Växjö, where mini-roundabouts were implemented as an area-wide measure.

### 3.4 Problem solutions from aspects society – man – machine - road

We structured the solutions in a hierarchical manner, by starting from the most general goal on the macro level, and then going down onto the micro level solutions. The solutions were based on the problem areas described above. We had four main solutions to the pedestrians problems related to safety and other aspects of the quality of life:

- reduction of motorised traffic
- planning in order to reduce encounters
- pedestrian-friendly design for encounter locations
- redistribution of responsibility so that car drivers get more responsibility and do not just set the scene for vulnerable road users
- reduction of vehicle speeds

### 3.5 Safety measures

On the macro level, one important measure would be to take care that the costs **of car traffic should include all external costs** caused by it i.e. also accident and environmental costs etc. Today, car traffic's attraction in relation to e.g. public transport is at least partly based on the fact that the costs of car traffic are much cheaper than those of public transport. The situation would be much more evenly balanced, if all transport modes would carry also the external costs caused by them.

**Long-term investment in public transport** is another measure that would help in the realisation of the solution of less motorised traffic.

Measures related to planning in order to minimise encounters could be **pedestrians-only areas in central business districts** and other **restrictions of car use**. These measures are best suited in areas with high pedestrian flows or where the number of child or elderly pedestrians are high, as in residential areas.

In order to improve the quality of life in urban areas, the planning should perhaps start by first planning the pedestrian path networks, and after that planning the motor vehicle road networks and separating that from pedestrians with the help of motor traffic tunnels and bridges instead of doing the opposite, which is the conventional manner. One way of saying this is to aim for **separation of cars from pedestrians and not the other way round**.

However, it should be noted that **good integration is often better than separation**. This is especially true in residential areas, where quite good results have been obtained through traffic calming, Woonerfs, and physical speed measures. When car drivers operate with the same speeds and prerequisites as vulnerable road users, the result can be improved quality of life for all.

**Telematics applications** can improve pedestrian safety, but only if they are designed in a very careful manner. If this is not the case, the car drivers will probably misuse the applications to increase only their own mobility and comfort, and neglect the needs of vulnerable road users. The telematics applications should enhance the interaction between car drivers and pedestrians, and make drivers act in a more attentive manner.

Pedestrian-friendly design in encounter locations means primarily improved **visibility of pedestrians**, increased **attention of car drivers and pedestrians** by various means, and **signal control also considering pedestrians** and their mobility needs on an equal base as the car drivers'.

At the macro as well as micro level, the most effective measures deal with speed control in various manners. The choice of the actual measure depends mainly on the implementation environment and its size. One promising feature would be a **speed limiter on vehicles**. It should be a dynamic one i.e. adapting itself to the surroundings (e.g. 30 kmph on residential streets, 50 kmph on urban main roads, 80 kmph on highways, etc.). Due to the foreseen resistance of car drivers towards such a device, it requires integration with some more “attractive” functions in order to make it acceptable. Such attractive functions could be e.g. intelligent cruise control, automatic lane keeping, etc.

The good safety effects obtained by **physical speed reduction measures and traffic calming** make them recommendable, although good detailed design is of utmost importance in their case. Good examples of this were presented by Miaden Gledec and Christer Hydén (see appendix). Among suitable measures are mini-roundabouts, humps, and rumble strips.

Signal control design can also affect driving speeds, and should not be forgotten in this context. The actuation of the signals and the green wave formation are two examples of signal control features influencing speeds. These micro level measures gain the most effective results when implemented according to a macro level strategy, which serves the purpose of comprehensive, area-wide improvement of pedestrian safety as well as road safety in general.

### Pedestrian Safety in Croatia<sup>11</sup>

In Croatia 800 people are killed in traffic every year (a rather high number for a rather small country (4.1 mio inhabitants). Therefore, a national program was established to improve traffic safety. This should be achieved by \*) reducing speeds (+ obedience of the speed limits), \*) improving pedestrian safety (e.g., obedience of red lights to 100% by car drivers, obedience at critical sites by pedestrians), \*) black spot treatment (30% of the most critical spots should be eliminated), \*) and improvement of the accident information system.

Especially for the pedestrians the situation should be improved by implementing a series of specific measures like \*) pedestrian information campaigns, \*) better traffic engineering measures (e.g., reduced waiting times at traffic lights, reduced vehicle speeds), \*) changes in town planning and land use strategies, \*) and traffic calming measures (that in many cases are the only possibility to improve the safety situation of pedestrians).

Some of these measures were tested in the field (2,7 km test route). Some rather positive results were achieved speed reductions

- o more homogeneous speeds
- o reduction in accidents
- o 200000 DM savings, while the costs of the measures (humps and other traffic calming activities) were only 14000 DM

### Pedestrian safety measures - past and future<sup>12</sup>

After a review of effects of existing pedestrian safety measures such as zebra crossings, refuges, traffic signals at intersections, mid-block signalisation, and speed reduction at intersections, the paper identifies road transport telematics (RTI) that may have the potential of improving pedestrian safety, viz. intelligent traffic signals, local speed reduction where and when needed, both warning and tutoring functions. RTI can help to warn drivers of pedestrians only in the actual situation when the presence of e.g. school children is really likely.

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See also M. Gledec, "Pedestrian safety in the first national safety programme in Croatia", in the appendix of this report

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See also M. Draskoczy & Ch. Hydén, "Pedestrian safety measures - past and future", in the appendix of this report

#### **4. Problem types and their appearance<sup>3</sup>**

##### *4.1 Pedestrians and other road-users: who has the power?*

###### 4.1.1 At the macro level

There is often a discrimination against pedestrians on social grounds, especially in the less motorised countries. It is, at least partly, a problem of social hierarchy as pedestrians include both the poorer part of the population and the most vulnerable one (children, the elderly, the disabled).

Even in Europe, there are still obvious traces of such discrimination in the traffic environment generated by road engineers up to the early 80's. In general, low attention has been paid by engineers to pedestrians in road design and facilities (narrowed pavements, scarcity of pedestrian crossings, introduction of pedestrian facilities as a last resort after all other goals have been taken care of, or other such shortcomings), which reinforces the attitude of drivers that pedestrians are negligible quantities with no particular rights.

The power game between the different road-users is also, to some extent, determined by the law. In general, traffic laws are meant primarily to keep vehicle traffic flowing smoothly, rather than to protect the walking population from such traffic (a pedestrian is not as dangerous as a car driver!). In actual facts, the law provides legal power to drivers. In such context, stronger regulations to protect pedestrians (as, for instance, in Great Britain) may not always have the expected effect, unless compliance by pedestrians is very high (the risk for offenders seems to be all the more severe that the regulations are strict).

In recent years, new local regulations applying to parts of urban areas have reversed the priorities, providing pedestrians with increased powers on limited territories (30 km zones, urban yards, mixed traffic streets, etc.). But the situation has not changed on rural roads and through villages or small towns, where the most serious accidents occur.

Pedestrians are not an organised force. In the less motorised countries, although pedestrians are the larger group of road users, they are particularly powerless to claim protection.

###### 4.1.2 At the micro level

In a traffic interaction between a pedestrian and a driver, there is a conflict of will. Who has more power? Some of the answer is in the traffic environment, some in the attitude of the driver. Are drivers particularly influenced by the volume of the pedestrian flow or by the category of pedestrian encountered (for example, are they more careful with a child pedestrian)? There are

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This chapter is based on the summary of the working group on "Problem types and their appearance" by N. Muhrad. Christine Chaloupka, Nicole Muhrad, Uwe Ewert, Tadeusz Rotter and Antoni Wontorczyk took part in this working group

some indications that being in a group confers some power to pedestrians. In individual situations, the drivers' feelings may be more diverse.

Drivers are not always aware of the risk they can generate to unprotected road-users, and of the amount of reaction they can expect from the latter in an emergency situation. This often contributes to delayed evasive action in a critical interaction.

The balance of power is particularly tilted in interactions involving a pedestrian and a heavy vehicle (bus, lorry). The consequences of a critical situation of this type are also particularly serious for the unprotected road-user.

#### *4.2 Pedestrian mobility and safety and the road infrastructure*

In general, little attention has been paid to the comfort of pedestrians when planning or improving roads and streets. Who is ever concerned with the fluidity of pedestrian flows? There have been very few studies of pedestrian needs in urban areas, although information could be gained by interviewing people. At the micro-level, pedestrians tend to be accounted for by engineers and planners through a simplified (and little explicit) model of the "standard walker" that crosses a street at 1.2 m/s, walks up steps of an overpass or underpass, and patiently waits at the kerb for the green sign. This takes into account neither the actual preoccupations and habits of pedestrians nor the variations of abilities and behaviour of a whole population. The pedestrians deviant from the model are usually the most vulnerable ones and the less able to cope with a critical interaction.

We still do not know much about pedestrian risk production. If, in urban areas, planners have brought some solutions to the pedestrian safety problem, it has been more through eliminating exposure than through decreasing risk (segregation schemes, re-routing vehicle traffic, etc.). Only the recent plans to reduce speeds have had that effect, as well as some traffic calming measures (see the French experimental programme "Safer cities with accident-less neighbourhoods") which work on the assumption that interactions between pedestrians and vehicles are made safer when the level of awareness of drivers can be raised through visible signals in the traffic environment.

It is to be noted that the intentions behind the implementation of measures apparently addressing pedestrian protection are not always as stated. For example, crossing facilities may be installed more to restrain pedestrian movements and limit the time when they may cross the street, thus facilitating vehicle traffic management, than to actually decrease their risk; some of the earlier pedestrian streets were implemented for economic reasons (the city centres had to become more attractive to potential shoppers) and not really for safety; etc.

#### *4.3 Specific pedestrian sub-groups: the elderly, the disabled*

There are specific safety problems with the elderly pedestrians: why are they more involved in accidents than the younger ones? Because of exposure? Observance of traffic regulations? Low motorization? Handicaps or disabilities? We have only scarce knowledge on most of these questions. Some investigations carried out in Switzerland show that exposure as pedestrians increase with age. From literature, it appears that compliance with regulations is no worse for the

elderly than for the younger pedestrians. Although driving practice of elderly pedestrians used to be low (for example, in 1978 in Switzerland, only 25 % of pedestrians over 65 involved in accidents had a driving license), it is now increasing: More and more elderly pedestrians have had some experience as a driver. Some disabilities do appear with age; in particular, decision time becomes longer. Also, attention is divided between surrounding traffic and other problems to be dealt with (stepping down from a kerb, etc.).

Road users tend to choose their traffic situations in relation to what they feel they can cope with. However, some aging pedestrians have not realised their loss of abilities and thus fail to adapt their behaviour. In addition, social disengagement of the elderly causes them to lose some of their aptitudes to communicate, which can be dangerous in traffic (when they are unable to interpret what other people will do). Improving the environment to make it easier to cope with for persons with decreased abilities should be one way to decrease risk.

#### Elderly pedestrians<sup>14</sup>

This paper indicates that one fourth of injured pedestrians and 60% of all fatalities involve persons of 65 years of age or older. With a 15% part in the total population in Switzerland, the 65 and older age group is well over-represented in the accident statistics. Possible causes may be

- a higher exposure for this group as pedestrians,
- a lower obedience to traffic regulations,
- less experience with motorised traffic,
- or psychological/physical handicaps that hinder effective participation in road traffic.

\* Exposure has an influence; whereas people up to the age of 50 participate in traffic as pedestrians for 20 to 30 minutes, elderly spend about 40 minutes per day.

Obedience to traffic regulations does not appear to be an explaining factor, elderly even comply better than other groups.

\* Elderly with a driving licence behaved more appropriately when crossing the street than those that never possessed one. Since the proportion of elderly with a licence is expected to increase steadily over time, a certain autonomous reduction in the number of pedestrian accidents can be expected without any additional efforts.

\* Literature gives a lot of evidence that the psychological and physical functioning of elderly deteriorates and puts elderly at risk in complex traffic situations. Behavioural observations of 880 elderly people crossing a two-lane road and interviews afterwards indicated that sixty per cent failed to look at all although a car was approaching. The crossing of the second lane appears to be more dangerous than the first one. After crossing the first lane elderly seem to keep going in accordance with Swiss traffic regulations. *Driving too fast by car drivers and high traffic volumes were most frequently mentioned by elderly as main problems as a pedestrian.*

Elderly road users are particularly sensitive to some life quality problems. For example, walking (or driving) at night in an environment with insufficient lighting will be particularly repulsive to them, on account of both feelings of insecurity and difficulties to cope with traffic. This means decreased mobility and social life.

## Elderly pedestrians<sup>15</sup>

Many studies have shown clearly that, when it comes to needs and interest that steer behaviour, all other data sets are more important than accident data. Especially the needs of elderly - as expressed by themselves - have to be analysed thoroughly in order to take decisions that really meet their needs (instead of just assuming that one does things that meet their needs, as is often the case).

It is to be noted that some disabilities start early in life or may be temporarily experienced by younger road users. Focussing on particularly vulnerable groups such as children or the elderly should not hide the fact that everybody may at some time become handicapped. Planning for the elderly and the handicapped should thus benefit everybody. Decision makers should be more aware of this!

One of the sources of temporary disability is alcohol. In some countries there is evidence that drunken pedestrians are a real safety problem, particularly on rural roads.

### *4.4 Pedestrian safety and other policies*

Pedestrian safety is to some extent a political decision, on the grounds that “it costs”. No strong stand can be expected when there are no pedestrian pressure groups. Traffic safety is not the main care of decision-makers. For example, air pollution has been a better argument for reducing car traffic in urban areas than pedestrian safety; similarly, the traffic calming measures which have been implemented in European cities usually had multiple aims: improving safety, but also urban life (better access, less air pollution, less noise, greater quality of public spaces).

While traffic safety may benefit from policies aiming at other goals, it may also be in contradiction with some of these other goals, especially at the micro-level. For example, while public lighting tends to improve both personal security and traffic safety, underpasses under busy streets, meant to prevent accidents, are ill-used by pedestrians, partly for security reasons. While plantations may be used both to enhance aesthetics and to attract drivers’ attention to the urban quality of the area they are going through, ill-designed plantations may be a screen to visibility and generate accidents.

There is a trade-off between accidents and mobility. Accidents are not sufficient to represent the whole safety problem of pedestrians. In some particular areas, apparent safety (a low number of recorded accidents) may hide an actual loss of mobility: some walking trips are abandoned from fear of danger. The same is valid for public transport (that is often combined to walking): It may not be used if a risk of accidents is perceived by the potential users, as, e.g., may be the case for public transport (which often has to function as a complement to walking).

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See also Ch. Chaloupka, “Elderly people as pedestrians”, in the appendix of this report

#### Accidents in municipal public transport<sup>6</sup>

In Poland, the number of people that make use of public transport is still more than three times as high as the number of people that drive their own car. The condition of public transport vehicles, however, is relatively poor, resulting in break-downs, disturbance in transport service and even safety problems. An inquiry of 203 passengers revealed that 23% indicated to be at risk in a public transport vehicle due to driver's behaviour such as careless driving, sudden braking, and speeding in curves or while overtaking. Other issues related to dangerous design elements of the vehicles such as sharp edges, lack of handgrips, and even defective doors (3%) that open during the ride at unexpected moments. 18% indicates that automatic door control would increase safety. 62% of all accidents with public transport involvement occur at bus/tramway stops. ...% on straight road sections, and ...% accidents within the public transport vehicle (right numbers in figure 1, not included). The latter group consists of jamming in the door, by falling inside of the vehicle or even by falling out of the vehicle. Passengers indicate that a better organisation and several improvements in the ergonomics and maintenance of the vehicle could help considerably to bring the public transport at a higher level of service.

The mobility system is autoregulative: people tend, as much as they can, to avoid situations they feel they cannot handle. Decreased mobility subsequently causes some loss of social life.

#### *4.5 Goals for future action*

The following goals for future action were discussed in the working group and presented to the plenum, which approved:

##### 1 Formulate a philosophy

There is a need to formulate a philosophy under which the role and social place of pedestrians is rehabilitated. The point is to make pedestrians partners with equal rights on the roads. Principles should be specified for different social and traffic conditions (Western and Eastern European countries, less motorised countries).

##### 2 Generate a professional culture

The main actors in road safety policies are decision-makers (administrators at the national and the local levels), engineers and planners who are responsible for creating and managing the road and traffic environment, and educators that teach or train road-users (or train future decision-makers). Their specialisation in road safety is often minimal. There is a need to generate a professional culture, based on an acceptable philosophy and therefore focussing in part on pedestrian needs, abilities and specific problems.

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See also Rotter R. & Wontorczyk A.. "Accident impendency in the public transport system in Cracow", in the appendix of this report

### 3. Improve mobility and safety to improve social life

Mobility is a condition of social communication and of the fulfilment of everyday needs in our modern society. The road and traffic system is meant to provide such mobility for all road users. For equity purposes, particular attention must thus be paid to the needs of pedestrians.

### 4. Focus on the weakest elements of the traffic system

Improve the road and traffic system in order to facilitate the movements of the most vulnerable road-users (the elderly, the disabled) and make them safer. Such policies should not only decrease the risk of these particular groups, but also benefit all the road-users as their task will be easier and their temporary impairments better accounted for.

### 5. Avoid measures that stigmatise particular groups of pedestrians

Although some care has to be systematically be taken that measures aimed at other road-users should not penalise the most vulnerable groups, safety improvements for the elderly or the disabled should not result in visibly setting them apart from the rest of the population. The point is to integrate, not segregate.

### 6. Improve driver training

Introduce in driver training programmes more elements about interactions with pedestrians: where and when to expect them, how to manage them. Stress the role and rights of pedestrians, as well as their fragility as unprotected road-users.

### 7. Encourage the development of speed reducing measures in urban areas

There is a need to radically change drivers' attitudes and behaviour through all means possible. In addition to reducing accident risk, lowering speeds (and raising drivers' awareness of other road users) through environmental measures in urban areas creates driving situations which are totally different from those encountered in more classical systems providing full priority to motorised vehicles. Such policies particularly address city centres, (mainly) residential areas, and transition zones between rural and urban situations (entry to towns, city suburbs).

### 8. Change people's behaviour primarily through situational change

Given minimum standards of traffic education, road-users behave as well as possible. They react to situations and adapt in consequence. In spite of economic problems, changing the road and traffic system to provide road-users with adequate clues and encourage adequate behavioural changes may be the best chance of progress in traffic safety.

## *4.6 Research needs identified*

Although "future research" is part of "future action", this area is considered as so important that it has been discussed separately and is displayed as an extra point, below.

### **1. Accident factors**

As most of the past effort in pedestrian safety has been to reduce interactions between pedestrians and vehicles, little has been learned on how and why pedestrian accidents actually happen. Such knowledge should be necessary for further progress, particularly with regards to pedestrian accidents in rural areas or small towns.

## **2. Detailed exposure data**

Little is known of pedestrian risk because of lack of exposure data. Some research is needed on the selection of risk indicators and their measurement according to situations and groups of road-users.

## **3. Pedestrian needs and requirement**

More knowledge is needed on the role and importance of walking in everyday life and on the mobility requirements of pedestrians, in order to improve infrastructure and traffic planning and management.

## **4. International comparison**

Much can be learned through internationally co-ordinated research studies on specific social and safety aspects of the pedestrian safety problems, particularly as regards the most vulnerable groups.

## **5. Behaviour changes**

That pedestrians, particularly the elderly, adapt their behaviour to compensate for loss of abilities or difficulties to cope with complex traffic situations has been widely acknowledged, but research is needed on the phenomenon to size it and understand it better.

## **6. Pedestrians and the law**

The legal rights of pedestrians vary from country to country and also tend to change in time (see new local regulations). To some extent, they are reflected in road planning and safety facilities. An international comparative study of the rights and role of pedestrians in traffic through laws and regulations should provide a valuable background to the study of behaviour and of the effects of safety measures.

## **7. Specific pedestrian facilities and how they work**

There are often discrepancies between what pedestrian facilities are explicitly meant to achieve and why they have actually been implemented; also between how facilities are supposed to be used and how they actually work. More research is needed on a number of sites (pavements, crossing areas) in different traffic and legal conditions.

## **8. Influence of modal split and the provision of public transport on pedestrian facilities**

Research is needed on global safety issues related to transport planning. How does any change in modal split influence exposure and risk to pedestrians? What about the risk in trips to or from buses or other public transport vehicles? etc.

## 5. Problem analysis and evaluation<sup>7</sup>

In the group that dealt with this topic, work focussed on three aspects that are relevant especially in connection with work in the field:

- Problem analysis (Which are the pedestrian related problems and how do we detect them?)
- Countermeasures (How do we solve these problems?)
- Evaluation (How do we find out if a specific countermeasure is the proper solution to the problem?)

The relationship between these three aspects might be displayed as follows:

A->	B->	C->
Problem analyses	Solution/Countermeasure	Evaluation

It was decided to concentrate on different methods/techniques and discuss how appropriate they are in order to understand the underlying process. By this we mean the whole traffic process. An accident does not for instance just occur for no reason at all. By studying the processes in traffic it is possible to understand why and how certain characteristics in the process can develop into and create risky situations.

It also was found necessary to discuss the methods/techniques on two different levels

- pedestrian safety
- pedestrian efficiency/comfort

We discussed the methods/techniques one by one and filled in a table like the one below for each method. The signs in the table implies how good we thought the method was to

- A) detect and analyse safety and efficiency/comfort problems
- B) suggest safety and efficiency/comfort solutions/countermeasures
- C) evaluate the safety and efficiency/comfort solution/countermeasure

++	Very good
+	Good
?	Questionable
-	Inadequate
X	Irrelevant

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chapter is based on the summary of the working group on “Problem analyses and evaluation” by Å. Svensson. Marie-Berthe Biecheler-Fretel, Oliver Carsten, Magda Draskóczy, Herbert Gstalter, Richard van der Horst, Kirsi Pajunen, Irén Papp, Miklós Papp, Eero Pasanen, Pirkko Rämä, Arndt Schwab, Tamás Siska and Åse Svensson took part in this working group

## 5.1 Exposure

The question of exposure is relevant at many levels of problem analysis (accidents, conflicts, behaviour. In many traffic safety analyses it is convenient to find a risk ratio to enable the comparison between

- \* different types of road users
- \* different locations
- \* the before and after situation of an introduced countermeasure, etc.

This is however a complex task. We do still not fully understand the relationship between risk and flow. Recent research shows that it is not as simple as assuming a linear relationship. The conflict/encounter ratio is feasible to use both on a overall level but also to differentiate between age groups like children and elderly.

The “best” parameter to reflect exposure cannot easily be decided upon. Different measures of exposure could be

- \* number of encounters, e.g., in an intersection
- \* time spent in traffic e.g. for certain categories of road users
- \* total distance/time walking a year

Exposure data for the meso and macro level could be achieved from household interviews. The members of the household could for instance be asked about distance travelled and time spent in traffic. It could also be possible to let the members draw their route on a map for a specific trip in order to get an estimate of number of crossings. Counts are also necessary on the micro level.

## 5.2 Accident Analyses

Different use can be made of accident analyses, and in the group different usefulness was attributed to this type of data.

**A)** *For detecting and analysing safety problems, accident data analysis is often needed but insufficient.* The most appropriate way to use accident data is to use it for detecting problems on a macro level. On this level the number of accidents are usually high enough to point out problematic sections. In the table for accident analysis there is a small plus sign for detecting and defining safety problems.

**B)** *For the (ask of suggesting solutions (here could be situations when accident analyses is a usable tool, but perhaps not the most appropriate tool.*

**C)** *Very often it is necessary to wait several years before it is statistically correct to make a judgement based only on accident data.* So besides being a slow evaluation tool the time span also indicates that we do not always evaluate comparable situations, many dependent factors may have changed over the years.

It also was felt that accident analysis is not the method to use when it comes to efficiency/comfort problems, solutions, evaluation, although, being afraid of accidents influences comfort considerably. This, however, may be almost independent from “objective” accident data.

	Safety	Efficiency/comfort
A	+*	X
B	?	X
C	-	X

\*) needed but not sufficient

Accident analysis can be carried out on different levels, using different methods, some of which are displayed in the table before:

macro level:	E.g., surveys
meso level:	In-depth analysis with interviews with the road users involved, Interviews, e.g., to learn about the influence of alcohol and driving; to find out what makes drivers fail to perceive pedestrians, especially children. It can very well be the case that there is a pedestrian overload, that makes it a heavy task to be a pedestrian in urban areas.
micro level:	On line observation .continuous video recording at different locations (an example of this is the study Eero Pasanen showed in his presentation); this a roach would make it possible to put accidents in relation to other variables.

Then the question was raised about accident and exposure. Is the task to treat risk or what? If we are going to reduce risk in traffic then we must agree upon a common understanding of the phenomenon risk.

### 5.3 Traffic conflicts analyses

The use of traffic conflicts analysis has a lot of its justification in the drawbacks of accident analysis

- Conflicts are far more frequent than accidents
- Conflict analysis is a quick tool, very useful in before/after studies
- With conflict analysis it is possible to study the whole process preceding the conflict. There is a bigger opportunity to find causal relationships between factors in the traffic process and risk.

Conflict studies in connection with the pedestrian safety problem can be performed in mainly two different ways

- Follow pedestrians in order to detect conflict points.
- Observation at specific sites.

In the discussion regarding the potential of using conflict studies the following conclusions were drawn:

- A) In the phase of detecting and analysing problems, conflicts studies are very useful
- B) Conflict studies are also useful for suggesting solutions/countermeasures
- C) There is a big potential in using conflict studies for evaluating solutions/countermeasures

However, conflict studies have no relevance when it comes to efficiency/comfort problems (although higher risks to get involved in conflicts might influence both efficiency and comfort for pedestrians).

	Safety	Efficiency/comfort
A	++	X
B	+	X
C	++	X

#### Pedestrian behaviour and pedestrian signal design<sup>8</sup>

The EU DRIVE II project VRU-TOO is targeted to the specific problem of pedestrians crossing arterial roads, since arterials account for about half of the number of all pedestrian casualties and some two-thirds of pedestrian fatalities in urban areas. The project tries to separate cars and pedestrians through the use of intelligent traffic signals. Approach is to improve understanding of the behaviour of crossing pedestrians, to identify pedestrian problems, and to produce signal schemes that are better tailored to pedestrian needs. The potential benefit of detection of pedestrians that already use crossing facilities has been examined. A greater safety benefit will be obtained by providing immediate green on arrival than by reducing waiting times for those who have already stopped. Conflicts are mainly associated with those who do not stop. Signalisation on its own does not lead to safe conditions for pedestrians.

#### Blinking yellow and signalised pedestrian crossings<sup>19</sup>

45% of pedestrians in the Netherlands cross against red. To introduce blinking yellow lights and to let the pedestrians decide themselves if they should walk or not means that crossing will be a legal decision instead of a law infringement in many cases. The question is, how risky such a measure is. The authors have evaluated effects of blinking yellow light at 6 intersections in Delft with the help of

Video analysis

traffic conflicts observation accident analysis

The results indicate

- that the inclination to cross outside green has been doubled
- that there has been a considerable reduction in waiting times
- that there are longer initial gaps in average, but the acceptance of short gaps remains unchanged
- that there is a reduction in serious and slight conflicts

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See also “Pedestrian behaviour and pedestrian signal design” by Oliver Carsten and Frances Hodgson, in the appendix of this report

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See also “Blinking yellow at signalised pedestrian crossings. An evaluation” by Wiel Janssen & Richard van der Horst, in the appendix of this report

#### 5.4 Behaviour observation

There are a number of different behaviour studies to be carried out when it comes to pedestrian safety. Pedestrian safety is for instance dependent on

- \* motor-vehicle speed
- \* gap acceptance
- \* where in the intersection the pedestrians cross
- \* number of encounters or interactions and 50 on.

It was concluded that there should be a clear distinction between the observation of behaviour and the interpretation of behaviour. There is also a distinction between different levels of decision, namely the overall long-term strategic process and the decision taken in a single specific situation. This is important since the use of information differs between people, or between groups of people. In order to learn about the internal decision processes a more experimental method must be used.

The question of exposure is of course interesting in connection with behaviour observations, as well. Behaviour observation can be related to more micro level exposure measures than can be observed on the spot. Such an exposure measure may be encounters: An encounter is an interaction between road users when at least one of the road users adapts his behaviour because of the presence of the other. This adaptation is often mutual and includes a sequence of interactive behaviours. Behaviour observation studies usually concentrate on the behaviour of one of the partners because of the difficulties in describing mutual interactions.

The table below reflects the fact that behaviour studies can be found where this method allows a good or even a very good approach. According to such findings,

- A) behaviour observations support the detection and analysis of both safety and efficiency/comfort problems
- B) that they help to develop suggestions for solutions/countermeasures both for safety and efficiency/comfort problems
- C) that they are necessary for a sense-full evaluation of solutions/countermeasures both for safety and efficiency/comfort

Studies for detecting and measuring efficiency are for instance waiting time studies, delay time studies and route choice studies.

	Safety	Efficiency/comfort
A	+	+
B	++	++
C	+	++

The effect of different timing schemes on pedestrian behaviour at signal controlled junctions<sup>20</sup>

In a field study three different signal timing schemes were compared, a conventional traffic actuated scheme, a fast mode traffic actuated scheme (pedestrians got faster green), and a fixed-time control. Based on six hours observations of conflicts no safety difference was observed among the schemes. Waiting times for pedestrians were longest for the fixed time control as expected. The fast control scheme reduced the waiting time for pedestrians at two of the three locations, whereas the number of pedestrians crossing against red increased. Signal control schemes tailored to each individual intersection function best with respect to pedestrian comfort than just simply making the control faster.

### 5.5 Interviews

This method can be used sensefully both on the micro-, meso- and macro level of both problem definition, development of countermeasures/solutions, and their evaluation.

micro level: A controlled way of getting to know details in different situations. Both in-depth accident analyses and conflict analyses could benefit from interviews with the road users involved. In combination with accidents it is however clear that factors like blame and fault can play an important role in the way people answer. This is however not a problem when interviews are made with road users involved in a conflict. Field studies indicate the opposite, it can put valuable information to the understanding of how and why risky situations occur.

meso and macro level: For the overall planning, for the analysis of mode and route choice of different groups. More favourable for efficiency studies than for safety studies.

The following scheme reflects the efficiency of interviews as a method in connection with our problem area on all levels:

	Safety	Efficiency/comfort
A	?*	+
B	?	+
C	?	+

\*) in combination with other methods

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See also “The effects of different timing schemes on pedestrian behaviour at signal controlled junctions” by Kirsi Pajunen. in the appendix of this report<sup>20</sup>

### Children's street crossing strategies - an observation technique<sup>21</sup>

In this part of the project, the goal was to find out which are the most relevant behaviour variables of children in traffic. In studying essential variables there were two important points of view:

\* Children's behaviour should not be examined in isolation from its environment. This means both the traffic and the social situation of the children.

\* Increasing attention should be paid to the children's own thoughts and rationality.

A new method for investigating children's behaviour when they are crossing a street was developed in the study. The method involves making video-recordings of children and traffic situations and two interviews with the children. The first interview took place immediately after a child had been filmed crossing the street, the other on the following day in school. Each child could then first watch his/her behaviour when crossing the street the previous day on the video. The child was encouraged to freely comment on his/her own behaviour and thoughts. After that, a more structured set of questions was presented.

### 5.6 Mathematical modelling

A mathematical model is useful as a prediction tool. Different situations can be simulated and the result is an estimate of the accident outcome. On a micro level specific interactions could be interesting to simulate. The problem is that the outcome of such a model would be very general. It would not be possible to predict individual behaviour. These models work with aggregated data

To be able to set up a satisfying model, the variables that influence the accident outcome must be known. Is there a common understanding of which these relevant variables are? There are a number of questions to be answered. Do we for instance model the pedestrians to arrive randomly and cross randomly? Speed influences accident rates and injury rates. To what extent? What speed? The average speed or the 85 percentage? Analyses of the video recorded accidents shown at Eero Pasanens presentation suggests that the most interesting speed is the speed of free flow vehicles (that are not part of a queue and the speed of which is not directly influenced by other vehicles, thus). These were the vehicles most often involved in accidents with pedestrians.

A) Could a model be helpful in the analysis of a problem? The question is; where do we have a problem? A more thorough screening should take place at sites where we have a higher accident rate than could be expected from the model.

B) Solution: What can we expect in terms of accidents/conflicts/behaviour if we change the geometric design (if a zebra crossing is introduced for instance)?. Gradually different solutions can be "tested" systematically with the help of mathematical models.

Oliver Carsten told us about a model developed in a DRIVE project called VULCAN. This model is route-choice based and the choice of route depends on delay which for instance depends on the signal timing, layout and S0 on. Then there are different safety aspects for different routes.

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See also "Children's street crossing strategies - an observation technique" by Pirkko Rämä, in the appendix of this report

Miklós Papp suggested a mathematical model that expressed safety in terms of number of accidents, conflicts, encounters, complaints with number of pedestrians as the denominator.

In the group discussion it was pointed out that the number of pedestrians can not be the best denominator in a safety equation. That should instead be some measure of safe interaction between cars and pedestrians, e.g. “encounters”. It was also agreed that this certainly needs more discussion in the future.

	Safety	Efficiency/comfort
A	+	+
B	++	++
C	?	?

#### Traffic simulation in pedestrian safety research<sup>22</sup>

Keeping speed limits of 40km/h in the city centres leads to reductions in death toll of up to 1/3. At the same times, travel times increase only to a very low percentage. Such speed changes can be illustrated nicely with the help of simulations (HUTSIM). Analyses of accidents on video show that the main problems “construction” consists of free vehicles (= single vehicles that are not in queue) driving fast combined with pedestrians who make errors, though, not consciously. Pedestrians in most of the accident cases in Helsinki behaved headlessly. Especially in connection with children it can be said that not bad assessment of vehicle speeds is the problem but their impulsiveness. Drivers do not feel any risks, biologically, when confronted with pedestrians and when driving at their own chosen speed. Thus, they have difficulties to reduce speeds consciously by themselves. This means that speeds must be reduced by force. What can be done to console car drivers is, however, to make speed reducing measures less painful for car drivers.

#### 5.7 Controlled experiments

Here it was agreed that controlled experiments could be very useful for understanding the process and defining the problem to be analysed. It could be possible to define hypothesis from data in real traffic. One could test these hypothesis in a controlled experiment and then return to real traffic in order to implement a tested countermeasure in order to see how it turned out.

Controlled experiments can be carried out

- in the laboratory
- in the field

Both kinds of experiments can be of different level of depth (from observing behaviour to measuring physiological indicators)

<sup>22</sup>

See also “Traffic simulation in pedestrian safety research” by Eero Pasanen, in the appendix of this report

	Safety	Efficiency/comfort
A	++	++
B	+	+
C	?*	?

\*) the question-mark is regarding the validity of controlled experiments

### 5.8 Activities considered as most important for the (near) future

The working group identified several activity areas that should be dealt with (more) in the future, and the ideas were presented to the plenum

#### 5.8.1 Better use of video-recording

Projects with the aim to combine the different safety evaluation methods should be carried out. With the help of video recordings, possibly including image processing, it would be possible to do a joint data collection. Then, each and every partner involved in the project would be able to carry out his/her own analysis. At the end results of all the different types of analyses involved could be integrated.

#### 5.8.2 Improve task analysis

It is necessary to further elaborate on how pedestrian traffic and pedestrian interaction with other road users and with the environment should work.. The goals to be achieved by better planning should be related to safety, comfort, and efficiency. Critical elements of behaviour; international communication (or encounters, as they have been called before), errors and violations have to be defined or operationalised with these goals in mind.

#### 5.8.3 Improve registration of pedestrian conflicts

Further studies have to be carried out to learn more about the relationship between conflicts with pedestrians involved, and the “real” risk they reflect.

## 6 Conclusions

This report summarises the discussions and presentations of the ICTCT workshop held in Prague in October 1994. There, it has been tried to discuss the situation the “pedestrian” is in in today’s road traffic.

### 6.1 Problem identification and definition

The analysis of this situation aimed at identifying problems connected to walking. It was generally agreed upon that there have to be certain preconditions in order for people to be prepared to walk to a larger extent. *Among others, this is an important point because in many countries and cities - at least in Europe - efforts are made to reduce the speed with which car traffic increases. To achieve this, people have to be prepared to accept alternatives, and, e.g., walking could replace short car trips, or, in connection with public transport, even longer ones.*

However, in order for people to accept it as an alternative to car use, the preconditions for walking have to be attractive enough. It has not been studied in detail, yet, what preconditions have to be fulfilled so that walking is really experienced as an attractive option by different groups and people in society. *But generally, one can assume that it should be safe, comfortable (i.e., not more difficult than absolutely necessary in a physical sense), and not too time consuming, and the people who walk should be led through an esthetically attractive environment.*

As life and traffic in the cities consist of a large number of different activities, including traffic participation in different forms, monofunctional solutions do not work. When analysing the situation of the pedestrians, identifying problems, and looking for solutions, therefore, one has the difficult task, to consider different people, groups, needs, interests, functions of structures (e.g., laws, regulations and habits) and infrastructures, etc.

Clashes of interests are to be expected and a general way to solve problems will be to find compromises. This is a very complicated task, and this means that the basis for decisions has to be sound. *I.e., what different people and groups want and need in order to co-operate to a satisfying degree - so that traffic planning becomes more than just a hazard game - has to be studied thoroughly.*

### 6.2 Problem location

The working group that dealt with the problem-location question listed \*) *developing countries, \*) big cities (accidents), \*) rural communities (fatalities) and \*) low income of families as main locations or contributing factors on the macro and or meso level.*

On the micro level \*) *high-speed drivers and \*) motor vehicle speeds in general, \*) central business districts of the cities, \*,) residential streets (children) and \*,) junctions and intersections* were named.

A very interesting conclusion was that ***the overall problem is the fact that car drivers set the scene for other road users.*** One example from the micro level (see above) is a highly overspeeding driver: As the car moves along the street network other drivers and especially vulnerable road users immediately have to react defensively in order to maintain their safety and health. *The car drivers can force the situation in their favour by various means, and one of them is speed.*

### 6.3 Policy goals

The working groups and the plenum implicitly agreed upon the goals for further work, both scientific and practical, in connection with walking:

- One conclusion of all the arguments listed above is ***that car speeds have to be controlled better than they are today.***
- A more generally formulated goal is *to improve the quality of life in the society by improving that of pedestrians.* This means that we should aim for improving the pedestrians'\*) mobility, \*) safety, \*) feeling of safety.
- Those people who have no other possibilities than to walk (many elderly, children, youngsters) should have *sufficient mobility so that they can maintain their social networks*, and participate in their normal activities without any needs for special solutions.
- The subjective safety of pedestrians (and of course that of other vulnerable road users) should be at least on the same level as that of car drivers and passengers. \*) On the macro and meso level, *the feeling of unsafety should be so low that it does not affect the pedestrians' mobility nor cause any anxiety on their part.* \*) On the micro level, *a certain feeling of unsafety might be beneficial to the objective safety of pedestrians, by making them attentive in risky road and street environments.* (This means of course, on the other hand, that streets and environment have to be designed in the objectively safest way).
- Last but not least, a goal is *to improve pedestrians' general role in transport policies, planning, engineering, product design, etc.* This would ensure in the long run that the safety and mobility requirements of pedestrians are fulfilled.

### 6.4 Recommendations

#### 6.4.1 Recommended steps of future action

The working group dealing with problem types and their appearance arrived at some conclusions that are actually a continuation of what has been reported so far. The following *steps of future action* were listed:

- 1 ***Formulate a philosophy*** (There is a need to formulate a philosophy under which the role and social place of pedestrians is rehabilitated. The point is to make pedestrians partners with equal rights on the roads. Principles should be specified for different social and traffic conditions (Western and Eastern European countries, less motorised countries).
- 2 ***Generate a professional culture*** (The main actors in road safety policies are decision-makers [administrators at the national and the local levels], engineers and planners who are responsible for creating and managing the road and traffic environment, and educators that teach or train road-users [or train future decision-makers]. Their specialisation in road safety is often minimal. There is a need to generate a professional culture, based on an acceptable philosophy and therefore focussing in part on pedestrian needs, abilities and specific problems).
- 3 ***Improve mobility and safety to improve social life*** (Mobility is a condition of social communication and of the fulfilment of everyday needs in our modern society. The road and traffic system is meant to provide such mobility for all road users. For equity purposes, particular attention must thus be paid to the needs of pedestrians).
- 4 ***Focus on the weakest elements of the traffic system*** (Improve the road and traffic system in order to facilitate the movements of the most vulnerable road-users [the elderly, the disabled] and make them safer. Such policies should not only decrease the risk of these particular groups, but also benefit all the road-users as their task will be easier and their temporary impairments better

accounted for).

- 5 ***Avoid measures that stigmatise particular groups of pedestrians*** (Although some care has to be systematically taken that measures aimed at other road-users should not penalise the most vulnerable groups, safety improvements for the elderly or the disabled should not result in visibly setting them apart from the rest of the population. The point is to integrate, not segregate).
- 6 ***Improve driver training*** (Introduce in driver-training programmes more elements about interactions with pedestrians: where and when to expect them, how to manage them. Stress the role and rights of pedestrians, as well as their fragility as unprotected road-users).
- 7 ***Encourage the development of speed reducing measures in urban areas*** (There is a need to radically change drivers' attitudes and behaviour through all means possible. In addition to reducing accident risk, lowering speeds [and raising drivers' awareness of other road users] through environmental measures in urban areas creates driving situations which are totally different from those encountered in more classical systems providing full priority to motorised vehicles. Such policies particularly address city centres, [mainly] residential areas, and transition zones between rural and urban situations [entry to towns, city suburbs]).
- 8 ***Change people's behaviour primarily through situational change*** (Given minimum standards of traffic education, road-users behave as well as possible. They react to situations and adapt in consequence. In spite of economic problems, changing the road and traffic system to provide road-users with adequate clues and encourage adequate behavioural changes may be the best chance of progress in traffic safety).

#### 6.4.2 Methodological recommendations

The working group dealing with problem analysis and evaluation, beside dealing critically with analysis methods used frequently nowadays, also discussed new (or "new") methods, that should be developed, or used in a more appropriate way, or used more frequently in the future:

*Efficient use of video-recording:* Projects should be carried out with the aim to combine the different safety evaluation methods. With the help of video recording, possibly including image processing, it would be possible to do a joint data collection. Then, each and every partner involved in the project would be able to carry out his/her own analysis. At the end results of all the different types of analyses involved could be integrated.

*Elaborate on task analysis:* It is necessary to further elaborate on how pedestrian traffic and pedestrian interaction with other road users and with the environment should work.. The goals to be achieved by better planning should be related to safety, comfort, and efficiency. Critical elements of behaviour; interaction/ communication (or encounters, as they have been called before), errors and violations have to be defined or operationalised with these goals in mind.

*Improve techniques for the registration of pedestrian conflicts:* Further studies have to be carried out to learn more about the relationship between conflicts with pedestrians involved, and the "real" risk they reflect.

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## APPENDICES