

# Central European Solution for Mobility of Elderly:

## Clever Mobility and Transport Systems

### For Vulnerable Senior Citizens

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#### Abstract

The aim of our project TL02000559, sponsored by Technological Agency of Czech Republic, Prague, is to develop a new attitude to the mobility of our senior citizens, more age sensitive and based on possibilities they have in relation to sustainable green mobility. Nevertheless, it doesn't mean any reduction of mobility of the elderly. Mobility of elderly is necessity for their quality of life and should be supported by the improvement of transport systems. This enables their better inclusion in society. The source of the knowledge is public participation in the form of questioning the elderly citizens, transport experts and municipalities to understand the real problems they face related to transport.

#### Keywords

Transport; mobility, accessibility; senior citizens; traffic accidents; safety; security

#### Introduction

Due to demographic changes older and disabled people represent a significant and permanent growing part of Czech population (Fig. 1). There has been a progressive increase over the past decade in the social awareness of the requirements for older and disabled people throughout the Czech Republic and other parts of Eastern and Central Europe. This progression has moved from making provision for older and disabled people on a welfare-oriented basis, towards increasingly equal access to all facilities as a matter of human rights. Improving access to any form of travel will provide additional social, as well as economic, benefits at personal, governmental and commercial levels.

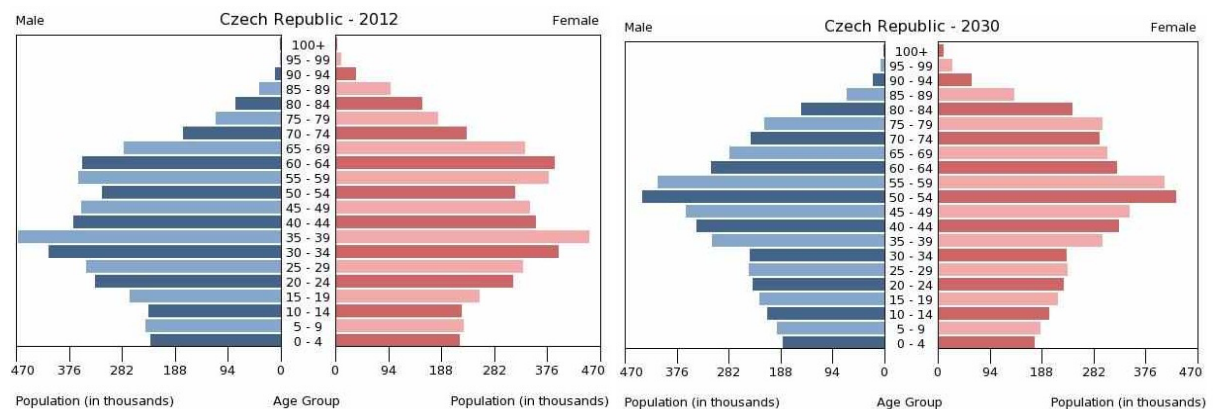


Fig. 1; 2: Division of the Czech population according age

## ***Materials and Methods***

### **Impact of Demographic changes**

Demographic trends indicate a marked rise in the number of elderly people in the population and there is a high correlation between age and disability. The share of elderly people in the total population is expected to rise from 21% in 2000 to around 31% by the year 2020 and to around 34% by the year 2050. Disabled people represent around 13% of the nation. Various initiatives recognise the needs of elderly people. The older generation as a target group is evolving; its size as well as structure and composition is changing (Fig. 2). The population of advanced European countries is getting older; pessimistic forecasts expect that within twenty years the number of post-productive citizens will catch up with and even exceed the numbers of other age categories. As to the structure, the number of women in this group prevails, and this is becoming even more distinct with the growing age. From the economic point of view, this group on the whole comes under poorer groups, which particularly applies to elderly people living alone (just one person without a partner or a wider family). The higher-age groups also include working citizens (in this group men prevail); senior citizens are often active members of various associations, clubs and other interest groups. Technical facilities of their households and availability of basic living needs enables them to live relatively independent lives in their permanent domiciles or even in their summerhouses.

Even though essential features are common, this group is becoming very heterogeneous as to the physical and mental health and overall physical and mental condition. The standing and needs of healthy seniors are significantly different from those of more or less ill individuals, not to mention the disabled.

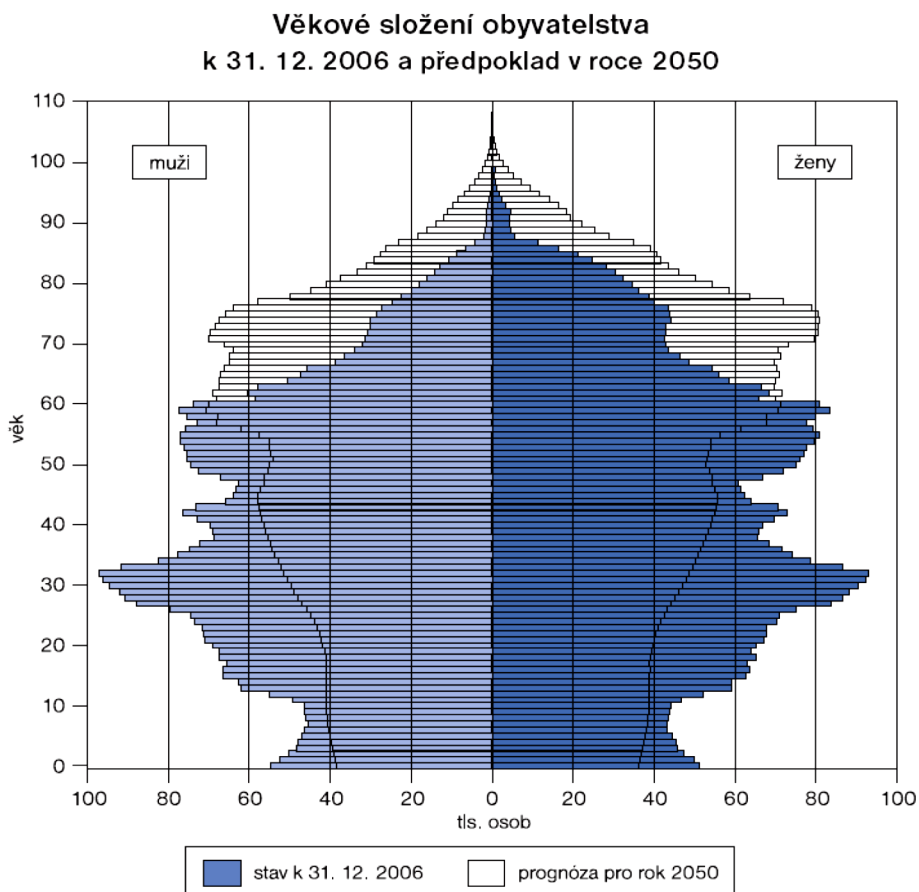
There would be no point to lengthening human life if this meant merely lengthening suffering for individuals and increasing problems for society as a whole. The aim both for ageing individuals themselves and for society is to delay ageing and, in close connection with the biological and social sciences, to seek ways of maintaining man's mental clarity and physical condition for as long as possible. The aim is also to find ways of compensating for the inevitable losses which come with increasing age, ways of increasing man's ability to adapt to the changes occurring both in his own organism and in the surrounding world, and ways of extending the period of time for which man is self-sufficient, useful to his surroundings and able to get something out of life for himself, without proving a burden to himself or his surroundings.

### ***Results the planners need to know***

The answers to the following questions in particular are closely associated with the quality of life of senior citizens:

- How is their lifestyle in old age related to their life up to that time, with the habits they have acquired, with the important events which have occurred in their lives, with their original life plans and the extent to which they have managed to implement them; what life strategies can then be recommended as being more successful, i.e. which will lead to better overall adaptation in later stages of life.
- What factors determine how people react subjectively to the fact of their own ageing, how they come to terms with the inevitable changes, how they are capable of maintaining a feeling of satisfaction in life at an advanced age, what psychological lessons can be used as a basis for preparation for their own ageing and how can they learn to make conscious use of the advantages of old age.

- How do social factors contribute to more or less adaptive (successful) ageing and what circumstances outside the sphere of influence of the individual can have a significant influence on the course of ageing; in what areas is there still great scope for society to improve conditions for its senior citizens in psychological and sociological terms, and so on.



**Fig. 3:** Forecast of the demographic changes according the Czech national Statistical Authority – Share of persons aged over 65; high, medium and low expectations  
Differences in age composition in the future (Czech Republic 2006 and 2050, Source: CSÚ)

## Age related personality changes and Traffic Safety

### Elderly drivers

Aged drivers suffer from physical and mental abilities worsening, blood pressure is unstable, visual sense or hearing is decreasing, reaction time is longer, need more time to make decision and to process information, their ability to learn new information is worsening etc... Elderly people are able to anticipate, their technical skill of driving car is fully automated, don't risk very much and drive slowly (Fig. 4).

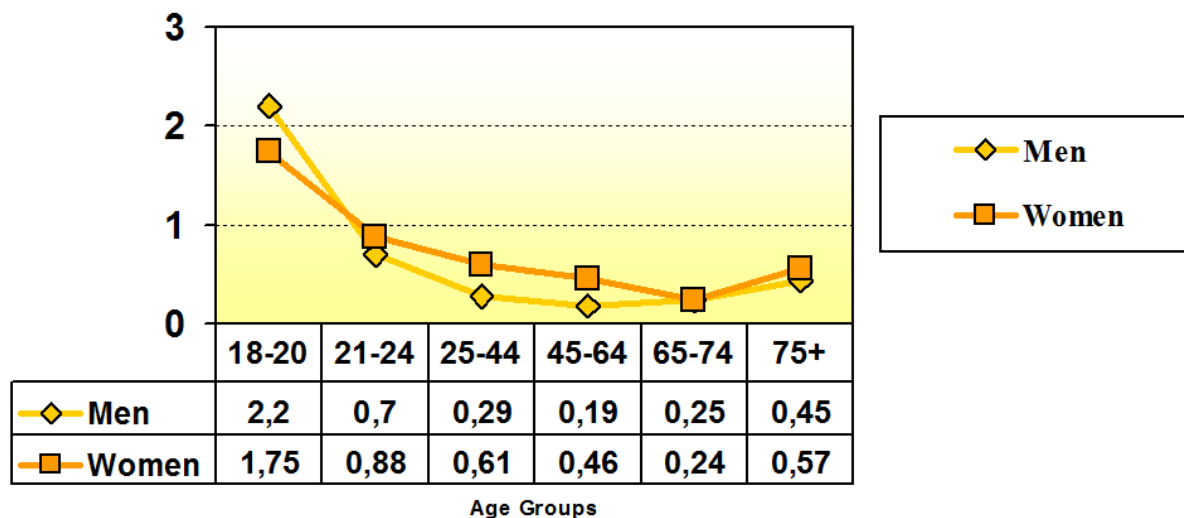
The road safety of older drivers is a point of public interest and critical discussion. Of course: deficits and losses in traffic relevant performances and capabilities could cause a higher risk of traffic accidents for older driver in relation to younger ones. Data from research (i.e. McGwin & Brown 1999) suggest that this is true in European countries. But the findings in the relevant European literature don't support this opinion. The age group with the – by far - highest risk is the group of young drivers and beginners between 18 and 24 years of age. Even if we take into consideration the reduced driving performance of the older driver and make a relation between number of accidents and driving performance (in km per year), we get no

other information: The older drivers are relatively sure drivers (Oswald 1999; Jansen et al. 2001, Hakamies-Blomqvist 2000, cit. after Jansen 2001). The accident proneness increases in old age (about 75 years) and in the case of a remarkable low driving performance (and that means: low practice).

Traffic safety – elderly drivers’ problems:

- Problems in complex traffic situations
- Difficulties to react in time
- Problems to use new technical equipment / lower adaptability
- Problems to develop new patterns and forms of skills and behaviour

Car driving in old age would be more safely, there are many ways to reach that: by altering construction principles of cars, by improving environmental elements and by changing behaviour strategies of the elderly their selves.



**Fig. 4:** Risk of accidents per 1 Million km driving performance

In relation to mobility for senior citizens we might mention a number of changes in the psychology of ageing people. The overall decline in performance is not the same in all areas. Certain capabilities and skills can, under favourable conditions, be maintained to an old age. The decline in certain mental functions occurs gradually, in some areas as early as in middle age (Fig. 5). With ageing the functional capacity of the organism declines in two principle areas:

- Worsening perception and information processing or declining ability to evaluate information.
- Worsening motor skills, i.e. a decline in the ability to master one’s surroundings (e.g. the controls of a vehicle) or one’s own body (reduced muscle power and possible arthritic problems reduce fitness). A specific change associated with the biological process of ageing is a slowing-down of mental processes, beginning with the phase of stimulus processing. Changes in perception play a part in slowing down reactions. Rapid and adequate responses are one of the conditions to safe driving.

Ageing also has an influence on thinking, memory, emotional life, motivation and other aspects of life, although as there are great individual differences in these areas no overall generalisation can be made. As in earlier stages of life social factors also play a role in determining mental development in old age. The social position of the individual changes, previous social relationships become impoverished, and one’s dependence on other people and on society increases.

Changes occur to one's values and motivations in the area of personality. One's attitude towards oneself and towards other people and society also changes. These changes to internal and external conditions place increased demands on man's ability to adapt. This ability to adapt is, however, itself reduced in old age, for which reason it is extremely important to prepare for old age. A great deal depends on the attitude taken to old people by society, the climate it creates for them (ageing), how it respects their right to a satisfied life and what specific measures it takes in this regard. Most, however, perhaps depends on the individual himself. The important thing is when (if at all) one thinks about one's lifestyle and decides to make changes (with a view to one's future needs and life) and makes a realistic assessment of one's strengths and possibilities.

The following can be seen as the positive aspects of old age:

Old age does not mean degradation. Many of the changes, which occur, can be compensated for. Good mental and physical fitness can be maintained to a great age by remaining active and taking part in appropriate activities. Even old people can live happily, take part in social activities and even drive a vehicle safely, particularly if they drive frequently. Problems are particularly likely to appear in the case of a long break (several months for example).

Man is the only living creature that knows that he will grow old and is able to prepare for old age. His expectations may even be joyful – he will have more time for his interests and hobbies. He can, for example, spend more time working on his car and plan and make excursions.

### Senior Citizen and his needs

There is still great scope for society to improve the conditions necessary to a satisfied old age. Even in retirement it is possible to give people the chance of undertaking activities useful to society, to prevent the existential uncertainty of old age and the loss of social prestige, complete isolation, etc.

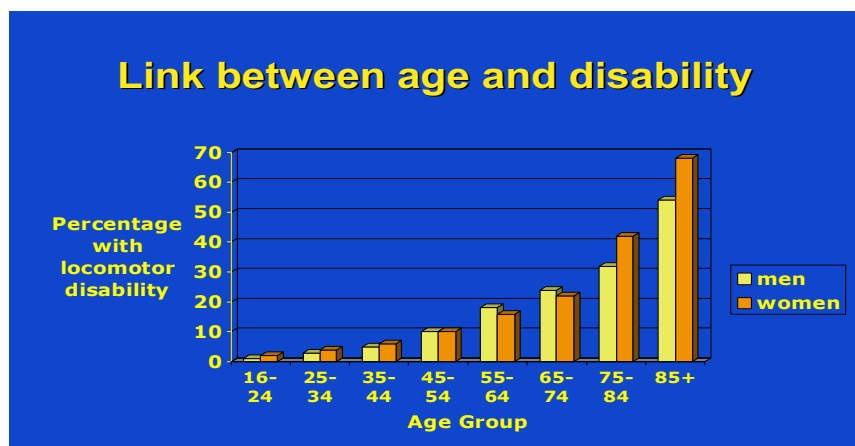


Fig. 5: Disability determination by age

The course of human ageing and the subjective experience of quality of life in this period depends to a considerable degree on the individual's expectations of old age, on how he reacts to the changes which have occurred, and how he manages to come to terms with them. One's attitude towards one's own age depends, first and foremost, on the way in which ageing takes place on the biological, psychological and social level. Man's initial experiences of his own

ageing generally induce unwelcome feelings. The changes noticed take the form of a progressive loss, decline and diminution, i.e. altogether a minus.

Under normal circumstances man is able to take a realistic view of his own ageing and has enough time to adapt to the changes occurring. In general, however, a feeling of dissatisfaction with oneself increases with advancing age. Old age places greater demands on the ability to adapt and exposes man to a greater psychological burden, which increases the likelihood of anxiety and neurotic difficulties. There is an important correlation between neurotic difficulties and dissatisfaction relating to one's health, marriage (and children) and the impossibility of making the most of one's abilities.

Among the factors contributing to changes in self-perception are shifts in the socio-economic status of the elderly and the attitude taken to the elderly by society. If a person is to maintain a feeling of satisfaction in life, then he must come to terms in an appropriate manner with the changes which ageing brings, and must find new forms of adapting to life. Man finds satisfaction in three principal areas of life – family life, working life and social life. The importance of these areas to overall satisfaction with life falls with advancing age, though not necessarily equally. Generally the richest source of satisfaction in life remains the family. The area of internal experience is generally of greater importance in old age. The question of quality of life and satisfaction in old age is important both for social practice and for the individual. Determining the degree to which a person feels satisfied is one of the principal indicators of personal adaptation in old age. A high degree of dissatisfaction with life may result in a pathological reaction producing complications both for those immediately affected and for society as a whole. Active people, with great creative strength and energy, enjoy a better chance of satisfaction in later periods of life.

The fact that for most people old age is accompanied by a significant change in their social standing and a number of other conditions is important from the viewpoint of quality of life, lifestyle and social factors. People who have gone into retirement involuntarily are generally less successful at adapting to ageing and tend to experience more psychological problems at a later age. Going into retirement generally means losing far more than just the opportunity to work. Economic status also changes along with social status, and the opportunity for social contact is also often noticeably reduced. In subjective terms people who have been of most use to society at a productive age, who liked their work and devoted their entire productive age to it, who have gained the respect of their colleagues, and so on, stand to lose the most. The role played by ageing persons within their own family also changes. Generally they no longer exert such an influence on younger members of the family as they did before. The status of older members of the family generally falls. Previous social contacts become fewer, as do the opportunities for making new contacts. This sudden loss of inter-personal relationships (the death of a spouse, a close relative or friend) is reflected in a worsening of both mental and physiological functions. It is impossible to prevent social losses. Society can, however, be expected to resolve the problems faced by lonely elderly persons in an effective manner.

### **Mobility behaviour and mobility satisfaction by the elderly**

The mobility of older people, which affects their access to facilities, decreases with increasing age. Not only do many of them become physically less able to move about but fewer own cars than other age groups. This may be less to do with age than with that generation of old people. Travel declines with age and this is sharper for women than for men. Elderly Czech women, many of whom probably never learnt to drive, were less likely to have a car than men, and people living alone were also likely not to have a car.

## **Subjective aspects**

A stressful factor for elderly citizens is their feelings of being excluded from the society, not being useful, fear of loneliness or non-prospective future. Their mobility may become one of the factors contributing to their more optimistic view. For example, in the investigation of mental condition of the experimental group of elderly drivers (Rehnová, 1990), questionnaire methods compiled for a “regular” population of elderly people focused on the detection of possible depression or loss of vitality have completely failed, particularly in the area of viewing the future, perceiving age-related problems, personal restrictions, etc., since no or very few negative views were formulated regardless of the citizens’ physical age or serious illness. The factor of strong dependence on being a holder of a driving license was ascertained (contrary to the actual driving): even though it was proven that further driving was risky, the persons involved were incapable of being self-critical, did not cope with the situation, remained helpless and often responded in a hostile and aggressive manner with feelings of injustice and wrongdoing. The immediate family is also often non-critical; on the other hand, well-intended efforts to discourage the granddad from driving are often perceived as the plotting of the family and more likely to arouse paranoid reactions than gratitude. Elderly drivers often have a personal relationship to their vehicle, for example formulated, as “we will make it to the end together”. Other researches also came to the same conclusion; it means that it is a mere myth that elderly people would be happy to voluntarily give up driving their own cars if a bus stopped right in front of their homes.

One of the general features of old age is a certain stiffness and adherence to the hitherto way of life, rigidity, unwillingness or inability to accept new ways of behaviour or come to terms with a new environment. Changes are adopted with negative feelings, surrounding activities including traffic are perceived as non-tolerant or even hostile. To be sincere, the reality is often reflected in these feelings: elderly drivers are perceived as slow and dangerous obstacles to those who love fast driving; senior pedestrians are not ‘fast enough’ crossing the road on zebra crossings and, furthermore, they walk wherever they wish to; elderly citizens in the means of public transport bother other passengers by wanting to sit down; on the whole, senior citizens create obstacles in the dynamic pace of life of younger generations.

## **Discussion**

### **Subjective experience and management of external conditions:**

Important are findings related to the “mobile performance” of senior citizens. Their most frequent activities are carried out in short distances, mostly on foot. Differences have been found between the population of cities and villages, between men and women, lonely persons and people living with a partner or a family. Women and lonely people usually move in the vicinity of their homes.

As to the involvement in traffic, elderly people are mostly pedestrians, bicycle riders (in the countries with cycling tradition), passengers, users of public transport, but also drivers. As to the sex, so far men have significantly prevailed among drivers; however, in the coming generation of senior citizens the share of female drivers is considerably increasing and when today’s pre-retirement generation gets old, this difference will be erased.

Ageing people need autonomy and mobility to maintain a high quality of life in old age. Less mobility implies also less social contact, more loneliness and decreasing physical and mental health. Safety and security is very important issue for the senior citizens (to be and to feel safe) - perceived lack of safety is stressing factor.

## Road Users as private car drivers

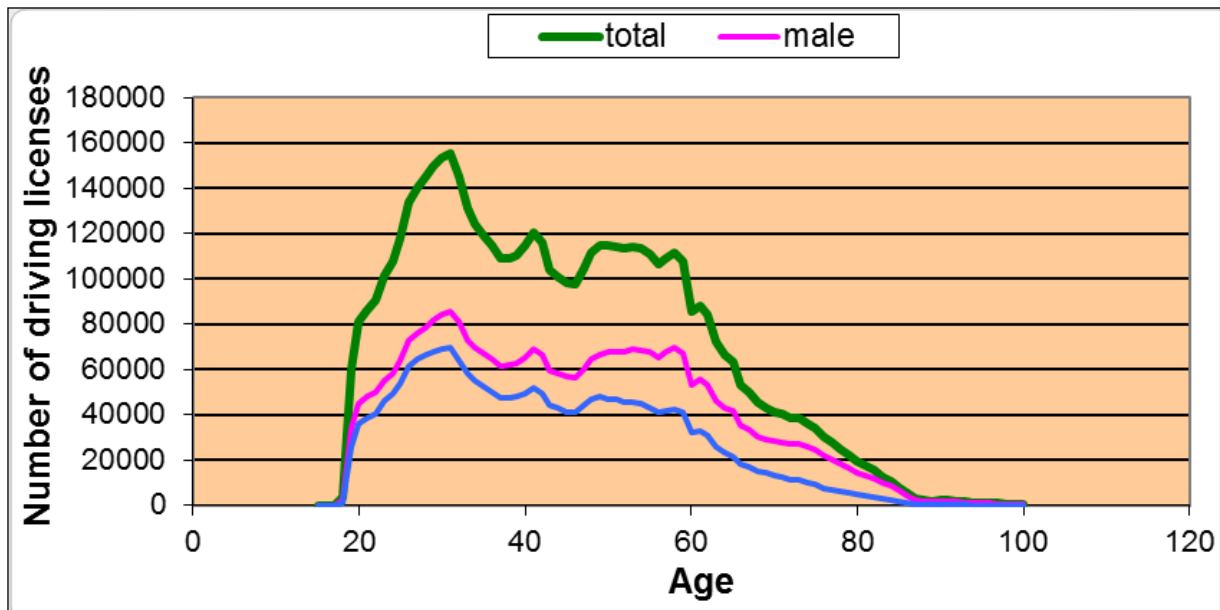
In modern societies owning and utilizing of a car is one of the best remedies against a diminishing of cruising radius in old age and a comfortable mean to sustain autonomy and independence of living as well as social relations. Physical handicaps of the elderly could be compensated. But in modern societies with its increasing proportion of older drivers' resentments against senior citizens as drivers of a car are widespread. Negative attitudes of the younger population could be barriers against a type of mobility of the elderly, which actually is a favoured one in our society. Scientific research shows that resentments against older drivers are not justified.

Because of the demographic process of societal aging the proportion of older drivers (60 years and older) to all drivers added up to 25 % In the future (2040) 25 % of the car drivers will be 65 years and older. To a great extent this development is due to the fact, that the older women are the most rapidly increasing group among the owners of driver licences. The degree of individual availability of a car among senior citizens is high. Following the Outdoor Mobility Survey of the year 1995 (see Mollenkopf & Flaschenträger 2001), nearly 80 % of the household of the seniors from 55 to 64 years of age have a car of their own (single persons less than couples or families). Regarding seniors of 80 years or older, 20 % of them have access to an own car anyhow. Men are better equipped than women; nearly all of the men of the "young old" group can actively participate in motorized traffic. Owning a driver licence and a car produces the need to use them and creates a sense of being integrated in the community of all citizens. A driver license and a car are very important aspects of competence and independency of the elderly people of nowadays. They are able to drive and they want to drive.

Because of the loss of occupational obligations older drivers have a less driving performance as younger ones, only 50 to 70 % of the younger drivers. We can observe changes in the face of aims or purposes of driving, too. Visiting relatives and friends becomes the most important purpose of using the own car in old age. This stresses the relevance of motorized mobility for the maintenance of the social network. A second important purpose is related to activities of supply in daily living (i.e. shopping), a third to leisure time and holidays (Gelau et al. 1994; similar: Jansen et al. 2001, but with subjects of 55 years of age and older).

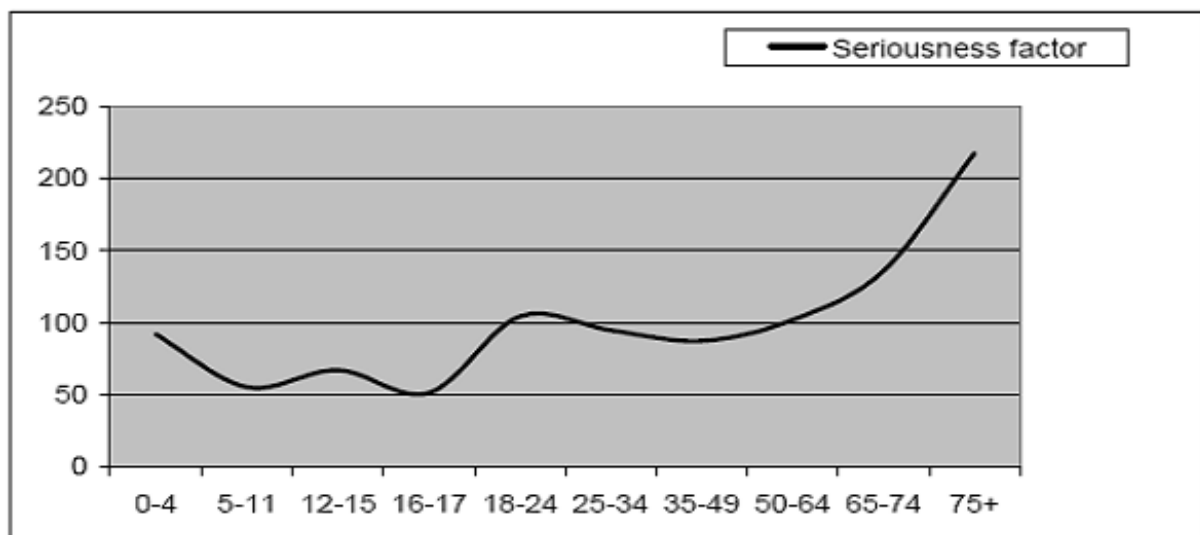
Driving as an individual's choice of transportation is a key issue for the mobility of the elderly. In the European society, the older population is increasing both in absolute and relative terms and there will be a corresponding increase in the number of elderly people holding a driving licence. The mean frequency of elderly drivers on European roads can be approximated to around 12% of all drivers today. This is expected to reach 20% by year 2010. During this process the numbers of older drivers will become evenly distributed between the genders due to an even more significant increase in the number of elderly female drivers.





**Fig. 6:** Gender and driving licence ownership (source: CSA)

Increases in age-related competences like defensive driving behaviour, and improved anticipation may compensate for age related decline in perception, cognitive capabilities and functioning. As a result, elderly drivers are usually not overrepresented in driving crash statistics. However, elderly drivers tend to be more often involved in specific types of crashes in situations, such as intersections or, when changing lanes, merging with traffic or leaving a parking position. Moreover, the prevalence of different illnesses leading to dementia in different forms is about 5-7% among the elderly. Many of these are currently not diagnosed sufficiently early enough by existing assessment schemes for elderly drivers.



**Fig. 7:** Driving and injury risk

At the pan-European level, current certification of “fitness to drive” schemes for ageing drivers differ widely between the member states of EU: in terms of periodicity of checks, assessment practices and tools, assessor profiles etc. Furthermore, basic information concerning the development of rational policies for deciding who should drive amongst the elderly driving population is currently missing.

## Impact of ITS use on traffic safety

To be mobile could be facilitated by implementation of additional safety measures in the streets to compensate aged-relevant deficits (like better illumination in streets, video-controlled public space, SOS-Telephones);

Promotion of driver-assistance systems in the cars and advancement of the demand for age relevant cars with high-tech-optimisation; With changing attitudes and conditions the desire to travel for education, business and leisure represents a potential major new source of ideas for IVIS (In Vehicle Information Systems) and ADAS (Advanced Drivers' Assistance Systems) designers and producers.

IVIS and ADAS appliances should help to the senior drivers:

- reduce the level of complexity and
- reduce the level of uncertainty
- offer an aid or substitution for deteriorating senses

What could the Intelligent Technical Systems improve in the future?

- They can reduce high speeds in particular situations, especially by the old or inexperienced drivers that depreciate the hazard connected with high rates in the turnings.
- Monitor the physiological state of driver (prevention of momentary drowsiness, fatigue etc.).
- Monitor the speed of the other cars, especially cars closely ahead of the driver (maintaining the safe distance).
- Warn the driver against overtaking at the moment when another object moves in the dead angle of the backward speculum, so the object is not beheaded by the driver.
- Warn the driver on the pedestrians and bikers on the crossings.
- Monitor other vehicles on the crossing shaped T and X.

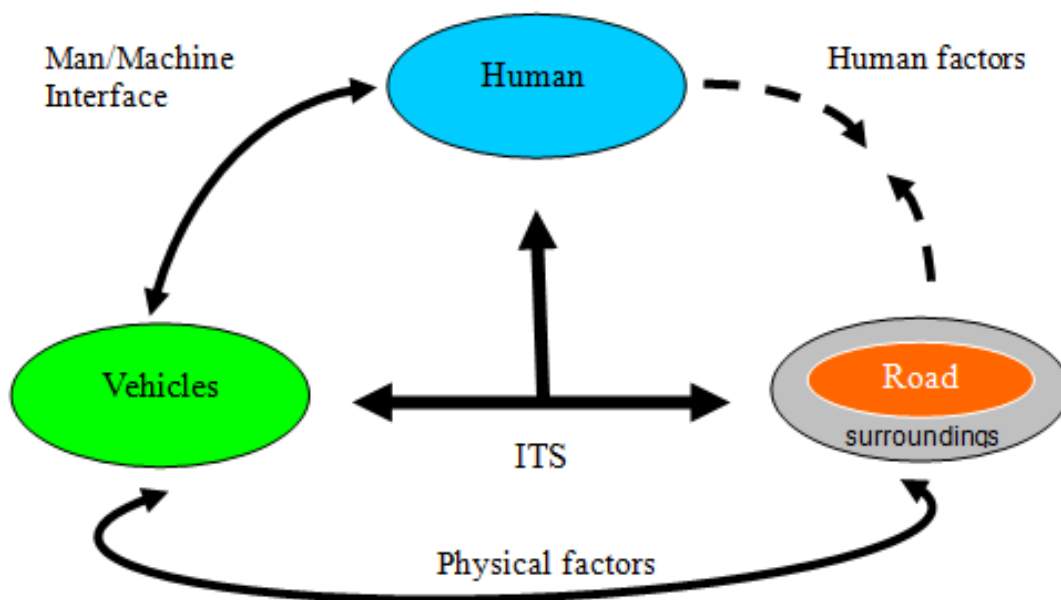


Fig. 8: CRASH FACTORS. ADOPTED FROM: VOLPRACHT, H. [1].

## Technical centred aspects

Elderly drivers have often problems with establishing positive relationship to modern technical devices. Aged drivers needs be taught how to operate such devices otherwise they will be frightened to use ITS technology. Automatic obstacle recognition, fatigue warning,

dynamic vehicle navigation, automatic distance keeping or lane monitoring seems to help these drivers.

The theory called “Theory about hazard homeostasis” is interesting if concerning road safety. Theory supposes that people have a tendency to keep the risk on constant level during driving. Any device or system originally designed in order to reduce danger on roads, will not bring the desirable effect because of this

The use of antiblock system is the classical sample of risk compensation. At the moment when the driver adapts upon this system, he drives with higher risk than at the time when he did not have the system yet. The research showed that drivers with the ABS were involved in traffic accidents on the same level as drivers without the ABS (Biehl et. Al., 1987). At the same time drivers in vehicles with systems that do not participate on driving (passive security systems – air cushions) do not embody any change in their style of driving. The ABS system retrenched the number of accidents with revolving vehicles and accident with pedestrians, bikers or animals. The expected accidents decrease with moving or static objects did not occur.

There exist three different hypotheses that try to explain why the ABS system did not bring the decrease in the accident frequency.

The drivers with ABS system behave unlike the drivers without the ABS. The system influences the driver in some areas.

At vehement braking the brake pedal vibrates and pushes back. Some drivers let go the brake pedal and the accident happens.

The Antiblock system reduces the friction during the vehement braking whereto would happen during the braking without this system. So, the braking distance prolongs.

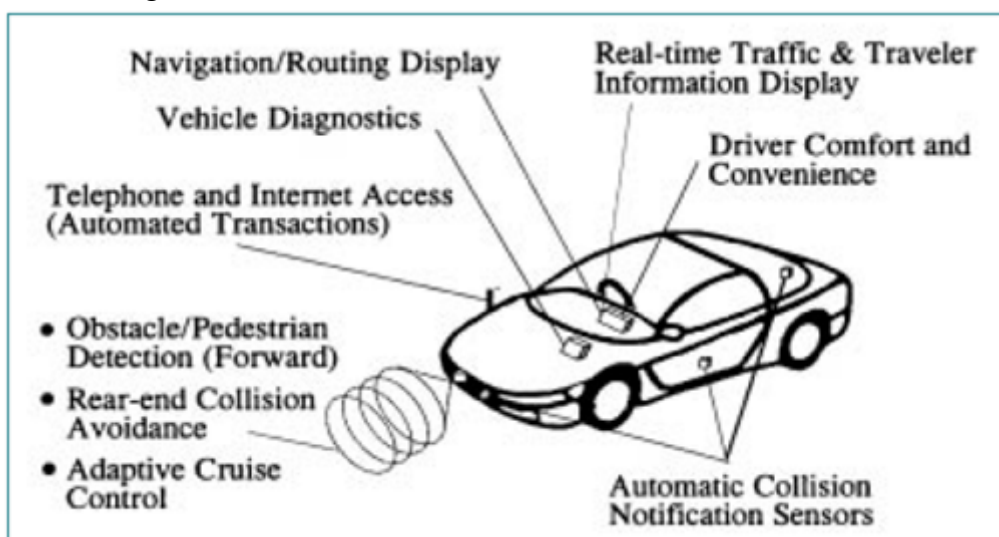
The common hypotheses concerning about loading the ITS in connection with the Theory of hazard homeostasis are:

Suggested incidences of ITS may be scotched and compensated by changes in driver’s behaviour.

Possible incidents of particular ITS are depended on our knowledge about these. The insufficient or missing knowledge may decrease the effectivity of ITS or may be directly harmful.

The possibilities included in the risk analysis that anticipate the ITS development may be insufficient, some areas could be overlooked

The technologies we can comprehend like the superstructure of the human organism, therefore the technology is able to bring the man to the situation, which he will not be able to cope. It can be dangerous.



**Fig. 9:** Assets of ADAS and IVIS

**•User friendly design and use**

- Support of self-confidence
- Bearable cost of the appliance or of the system
- Integration of the functions / simplification of the use
- Information campaigns among elderly drivers needed

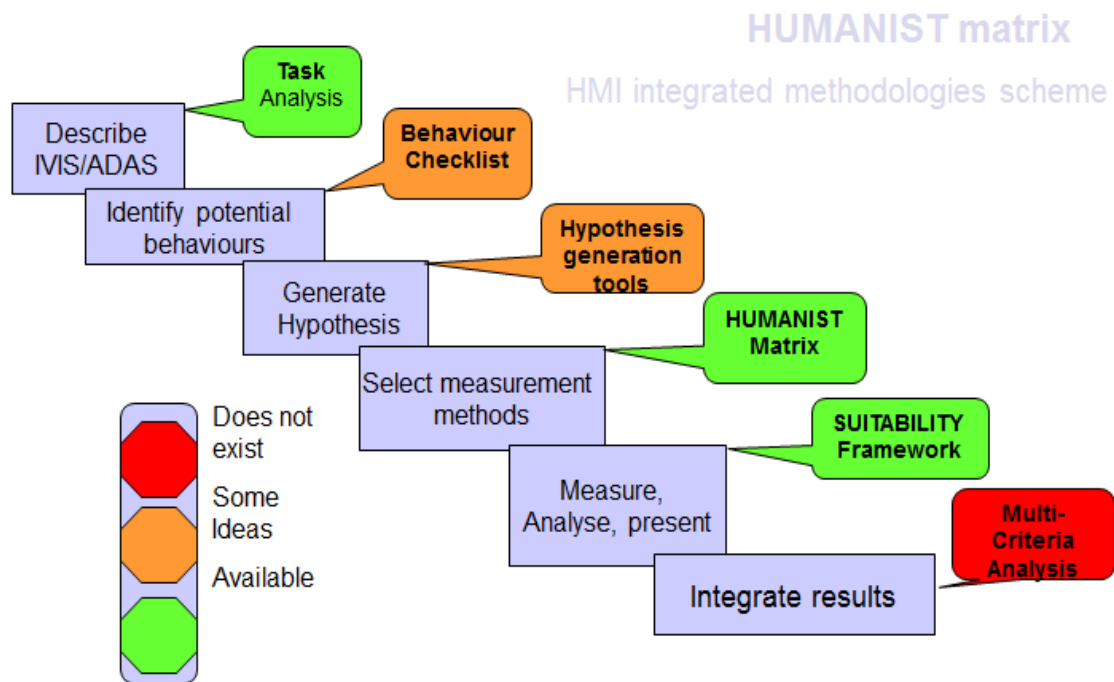
Compensation of degenerating physical and sensory abilities: *navigation, distance keeping, lane keeping, obstacles signalization, etc.*

**Potential drawbacks of ITS for seniors:**

- Information overload because narrower sensory capacity
- Danger of distraction because of slower reactions
- Loose of skills because of lower mileage
- Possible stressful impact of very complex situations
- Too much trusting on a system



**Fig. 10:** The main concern of the project was to evaluate the impact of IVIS - in-vehicle information technology on road safety by means of simulation studies and field studies with simulation and instrumented vehicles.



**Fig. 11:** Development procedure of new ADAS and IVIS

## Conclusion

It is expected that these technical means will be used to a far greater degree in the future for the purposes of preventing road accidents (active safety) and to reduce the impact of the road accidents that do occur (passive safety) to senior citizens. The use of telematic should help in preventing accidents. Technical development increasing the safety of vehicles for passengers need not be the privilege of a few. It will be necessary to co-operate with manufacturers to ensure that technical innovations are available to all and attainable as soon as possible for a wide range of new vehicles. The possibilities for equipping older vehicles already on the roads with new technical means of prevention should also be investigated.

Intelligent communication for transportation systems (such as ITS), combining and integrating the whole range of communication systems with logistical transportation systems, “intelligent” cars (telematic systems) and electronically managed road & rail traffic;

Sustainable technical development (including elderly people); “sustainable” means a mindset to realise compatibility of economic growth, social development and use of natural resources. Before implementation, modern technical solutions have to make up the balance in these main issues. Main design principles are: Senior drivers represent a potential major new source of ideas for IVIS and ADAS designers and producers. IVIS and ADAS are designed to reduce traffic accidents and to support elderly drivers in a suitable and user-oriented way.

## Jak bude automatický záchranný systém fungovat

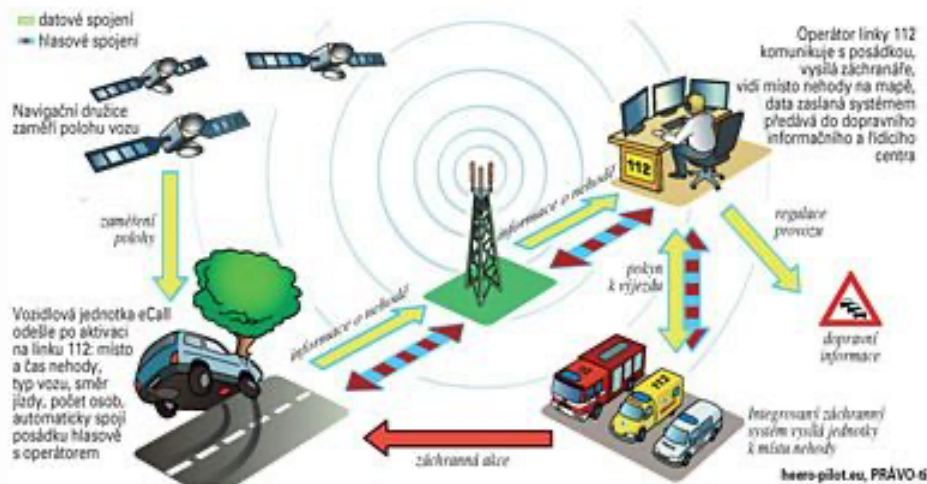


Fig. 12: Automatic rescue system, operational scheme

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