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GATHERING MULTI-VIEW DESCRIPTION OF CAR ACCIDENTS INVOLVING ELDERLY FOR FURTHER USE IN DESIGN REQUIREMENTS

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ABSTRACT

The proportion of older people in the population is rising, as is the proportion of older driving licence holders. The needs and abilities of older drivers therefore need to be considered in vehicle design. Our research is focussing on the multidisciplinary identification of design requirements for aged drivers. Research on older drivers has become a field of interest in various research domains and technical areas but coherent results are still missing. We need interdisciplinary approaches directly aiming at supporting older road users. We suggest a systemic approach in order to obtain detailed and comparable results stemming from different sources. In the present study we analyse information given in a database of accident analyses on 4 levels which helps us identifying the different points of view on the system. Our analysis is motivated by the need to contrast such diverse perspectives in order to obtain new perspectives and research directions. The systemic approach allowed us to make statements about the different points of view and their interrelation according to system. It also helps us to formulate further recommendations for the generation of research results in the field of older drivers to be able to develop car design requirements for older drivers.

Keywords: *Older Driver, Ageing society, Multidisciplinary Approach, system theory, Requirement Generation, Mobility, Quality of life*

1 INTRODUCTION

Mobility needs and safety issues of the ageing population have since several years become an issue of interest for research, industry and governments, especially in the industrialised world. In this context, special attention is paid to the particular case of older drivers. This development is due to the expected increase of percentage of older persons in the population. It can be estimated that by 2050 one quarter or more of the whole population of the OECD countries will be aged 65 and older. [1]

Eurostat supports these findings and anticipates that the number of elderly people aged 65-79 will increase significantly after 2010 and until around 2030 (+ 37.4%). With life expectancy increasing all the time, our societies are witnessing the presence of an ever-rising number of very elderly persons (80+): +17.1% between 2005 and 2010, +57.1% between 2010 and 2030. (Eurostat) gives a detailed overview about the expected demographic development until 2050.

This demographic development can mainly be based on two changes. Due to the progresses made in medicine and health care in Europe, life expectancy and health conditions are rising. As medical progresses are increasing fast they help to insure a longer life expectancy under generally better circumstances. A second influence on the current development is due to low birth rates in most European and North American countries. Fertility is below the population replacement level which leads to the above described demographic development.

As the number of persons owning a driving license is increasing at the same time a significant increase of older drivers can be foreseen [1], [2].

Eurostat base scenario, EU-25 (in thousands)	2005-2050	2005-2010	2010-2030	2030-2050
Total population	**-2.1%**	**+1.2%**	**+1.1%**	**-4.3%**
	(-9642)	(+5444)	(+4980)	(-20066)
Childern (0-14)	**-19.4%**	**-3.2%**	**-8.9%**	**-8.6%**
	(-14415)	(-2391)	(-6411)	(-5612)
Young people (15-24)	**-25.0%**	**-4.3%**	**-12.3%**	**-10.6%**
	(-14441)	(-2488)	(-6815)	(-5139)
Young adults (25-39)	**-25.8%**	**-4.3%**	**-16.0%**	**-8.0%**
	(-25683)	(-4037)	(-15271)	(-6375)
Adults (40-54)	**-19.5%**	**+4.2%**	**-10.0%**	**-14.1%**
	(+19125)	(+4170)	(+10267)	(-13027)
Older workers (55-64)	+8.7%	+9.6%	+15.5%	-14.1%
	(+4538)	(+5024)	(+8832)	(+9318)
Elderly people (65-79)	+44.1%	+3.4%	+37.4%	+1.5%
	(+25458)	(+1938)	(+22301)	(+1219)
Very Elderly people (80+)	+180.5%	+17.1%	+57.1%	+52.4%
	(+34026)	(+3229)	(+12610)	(+18187)

Figure 1 "Demographic changes in Europe."[1]

The importance of the topic is proven by a multitude of research projects and publications that highlight current developments. An important report entitled "Ageing and Transport: Mobility Needs and Safety Issues" has been published by the Organisation for Economic Co-Operation and Development (OECD). The authors have based their findings on literature and policy reviews, the analysis of demographic and statistical data and the study of recent research findings and case studies. Their objective has been to identify current and emerging mobility and safety issues arising from the ageing of the baby boom generation[2] and to develop policy and research recommendations to meet older people's transport needs while maintaining acceptable safety standards. [1] The study highlights special needs of aged persons and addresses open research questions to be considered in the future. It gives an overview about the state-of-the-art and gives significant information which can be used by researchers as well as policy makers in order to enhance safety and mobility of the older generation.
Before defining our research interest we want to start by giving an overview about the current state-of-the-art from a research point of view, which will help us to identify and describe our research questions and to embed the topic into a comprehensive context.

2 STATE OF THE ART

2.1 Evolution of this research field

Research on older drivers is a relatively new topic of interest although some general interest has already been expressed in the 1930s. A first important wave of research on older drivers happened by the end of the 1960s, mainly in the US. This wave has mainly been influenced by Thomas W. Planek who published several research articles and books, addressing the effects of ageing on the driving performance. In his understanding an older driver is a person 55 years or older, but he states that certain impairments, which could have influence on driving behaviour could already be identified from 50 years onwards. His main research interest was to identify deficits and impairments of ageing persons and to see them in the context of driving. [3], [4]
At that time the question of ageing and driving did not get much attention in Europe. Some age-related controls or restrictions concerning driving licensing have been introduced, but this topic didn't raise any common interest at governmental and research institutions. [2]
A report published by the Organisation for Economic Co-Operation and Development (OECD) in 1985, dealing with the safety situation of older road users and the current situation in research, finally encouraged widespread interest amongst researchers and governments. The report didn't focus on older drives, but approached the topic more from a generic point of view and discussed the problem of older road users in general. It discussed thus the presence of older persons as unprotected road users

[1] Communication from the Commission: Green Paper "Confronting demographic change: a new solidarity between the generations" 2005, page 4f
[2] The baby boom generation are those men and women which have been born between 1946 and 1964

due to the fact that they very over-represented in fatal traffic accidents and discussed the use of different travel options. [5]
In contrast to this research in the US focused at that time already at private car use. This is due to the circumstance, that in the US more people are living in rural areas, where a car is strongly needed for most activities in every day life.
Since then interest in the topic constantly raised not only in Europe and North America, but also in Australia and some Asian countries and is nowadays treated by a multitude of scientific fields and technical areas and evaluated from various points of view. It is a well established research field which attracts researchers from around the world and is a topic at several international conferences, such as:

- The annual IEEE Intelligent Vehicles Symposium (IV'07), with a technical focus
- the biennial ICADI International conference on aging, disability and independence, which will again take place in 2008 and focuses on independent living and assistive technologies
- the TRANSED 2007, 11th International Conference on Mobility and Transport for Elderly and Disabled Persons
- the AAAM 2007, 51st AAAM Annual Scientific Conference October 14-18, 2007 Melbourne, Australia, with a medical focus, but linking to Engineering topics

2.2 Localisation of the topic

If we take a closer look to the different research fields dealing with the topic, we notice that only few contributions appear under one research field. Most of them seem to cover several scientific fields which state the interdisciplinarity of the topic.
Beside scientific fields we also distinguish between different technical areas which have a proven interest in the topic. The following table gives a short overview about those areas we identified and explains their point of view.

Table 1. Technical areas

Technical area	Point of view
Accident Research	cause of accidents of older drivers
Safety Research	enhancement of older drivers' safety
Transportation Research	Improvement of road infrastructure for older drivers
Social Care and Well being	mobility of aged persons
Independent Living	remain independence and mobility of aged persons
Ergonomics	HMI for older drivers
Geriatrics	age related impairments
Improvement of life quality	mobility as an important factor of life quality for aged persons

The University of Alabama at Birmingham can be identified as a key player in the field. There is a strong collaboration between the different departments which states again the multidisciplinarity of the research topic. Departments involved from University of Alabama are: Center for Translational Research on Aging and Mobility, Department of Psychology, Ophthalmology, Epidemiology, Surgery and Medicine. The focus of this research team lies on the analysis of risk factors of older drivers, and is especially treating visual perception as a factor influencing driving abilities.
In Australia there is also one main research team with treats the topic; the team of the Accident Research Center at Monash University in Melbourne. Their main focus lies on environmental impacts and influences of older driver crashes and analyses road infrastructures and behaviour of older drivers in traffic.
In Europe the main actors can be found in the Scandinavian countries, where particularly the Finnish and Swedish are very experienced in the field.

2.3 Definition of “older driver”

In order to find a suitable definition for the concept “older driver” we used several sources. On the one hand we conducted an intense literature review considering more than 150 research articles. Although

some authors already talk about an older driver at the age of 55, [6] while others set their limit at the age of 75, [7] there seems to be a majority of researchers who define the older driver as a person above 65 years. [1] [2] [11] Some of them distinguish between older drivers and very older drivers who they define usually as the age group above 80 or 85. The different definitions are mainly due to different approaches and reasoning. Different research domains tend to use different instruments and parameters in order to observe and analyse age related changes and to obtain results.
On the other hand, we also considered the definitions of several Road Transport and Safety institutes for our reasoning. Here we found the same results as within research publications, which means that the common age is 65 years and older. Several institutes like the AAA Foundation of Traffic uses a three age thresholds: 65 and older 75 and older and 85 and older. [8] Based on these findings we define the older driver as follows, taking into account that individual needs might differ depending on the physical age, actual health conditions or psychological aspects of the aged person:
An older driver is a person of 65 years or older, who actively uses a car and who has proven physical and cognitive deficits and therefore has special needs in order to drive safely.

2.4 Age related changes influencing safe driving

Although life and health conditions for the ageing population have enhanced throughout the last decades, age related impairments still play an important role for older drivers. There exist different points of view, describing critical functions for safe driving which will be summarised in this abstract and which will lead to us to our own definition.

Brian Fildes and his colleagues from Monash University identified 3 critical functions for safe driving.

1. Vision – More than 90% of a drivers sensory input is claimed to be visual
2. Cognition & perception – considerable evidence shows that low cognitive functioning is associated with an increased risk of crashing
3. Psycho-motor fitness – while not as strong, evidence does show that psycho-motor fitness is important for safe driving

Paul Herriots, who conducted a research study for the Design Department at Land Rover mentions 5 different groups of age related changes, which impact on how older drivers interact with their vehicles. [12]

4. Physiological: decreased mobility & strength, hearing loss, reduced muscles
5. Sensory: more rapid onset of fatigue
6. Perceptual: visual deterioration
7. Motor abilities:
8. Cognitive abilities: reduced ability to process information, slowed reaction time

3 PROBLEM MODELLING

Mobility is a key to life quality and ensures an active life with access to social facilities and helps to maintain the independence of the elderly. This requires our societies to transform the services they are delivering today to cope with the new needs expected for the increasingly aged population.
We can thus summarise that, when people get older an age-related change in driving abilities can be associated. As the percentage of older drivers rises and as industry, research and governments are aware of the need to react on the specialised requirements of those persons numerous actions have already been undertaken and the car construction industry is now aware of some simple but very helpful improvements in cars.

3.1 A systemic approach

Behaviour in road accidents is complex. This is not due to the number of components involved in the accident occurrence, neither the number of variables interacting during the accident. Most of all, it is the non-linearity and the impossibility to predict the Driver-Vehicle-Environment system DVE behaviour that entails this complexity. This unpredictability is notably due to the fact that human actions are strongly involved in accident causation, and that human behaviour is unpredictable. Furthermore, during the road accident, the DVE system performs some functions (i.e. perception, interpretation, anticipation, decision, action), which generates transformations (i.e. new situation, new interpretation, new purpose, new requirement, etc.), which in turn generate new functions and behaviours, etc. Thus, DVE behaviour may be described through feedbacks and recursive loops.

According to Miller's definition of a living system [20], we define the DVE as an open and living system since each component (i.e. driver, vehicle, infrastructure, traffic, etc.) is constantly interacting with its environment by means of information and matter-energy exchanges. Due to these feedbacks and recursive loops, it is impossible for designers and accidentologists to identify with exhaustiveness and certainty all the failures dysfunction and mechanisms occurring in a road accident. Moreover, a similar accident may be seen differently according to the analyst's point of view. We assume that each expert in accidentology and each designer has an individual perception of the same phenomenon. Our assumption is based on constructivist foundations, which assume that knowledge depends on how the individual "constructs" meaning from her/his experience. A system, in a constructivist perspective, is recognised as a representation of reality seen by some people in a given context.

Our approach is then intended to identify and integrate the various viewpoints in accident scenarios construction and interpretation so as to be able to identify the specific knowledge that might be used in order to achieve in a more comprehensive set of requirements in the specific case of old drivers. For this purpose, we propose the systemic approach as a shared architecture between the accident analysts in order to understand and analyse accident scenarios. The systemic approach assumes that to handle a complex behaviour, it is fundamental to make a junction between the ontological, functional, transformational and teleological viewpoints. The reflexivity of the systemic approach is proven by the fact that every axe can be analysed according to all 4 axes again and consitently, as shown in figure 3.

• **The ontological viewpoint** (i.e. what is the system?): it allows a structure-oriented and contextual analysis of the system. In other words, it represents the sub-systems (the driver, infrastructure, traffic, ambient conditions, vehicle, etc.), their taxonomic groups, their contexts (the driver's professional status, family status, etc.), their structures, as well as the various interactions between these sub-systems and their components;

• **The functional viewpoint** (i.e. what does the system do?): it allows a function-oriented analysis of the system. It represents the global process of the DVE functioning during the road accident, which combines several procedures (perception, diagnostic, prognostic, decision and action);

• **The genetical viewpoint** (i.e. how does the system evolve? What does it become?): it allows a transformation-oriented analysis of the system. The DVE system behaviour can be described as an evolution that goes through several states. The transformational viewpoint integrates the accident's sequential and causal models developed by the INRETS and described in the next section.

• **The teleological viewpoint** (i.e. what is the goal or intention of the system?): it allows a goal-directed analysis of the accident. In other words, it assumes that each of the DVE system components or functions has to serve a purpose in an active context in order to ensure the safety of the DVE system

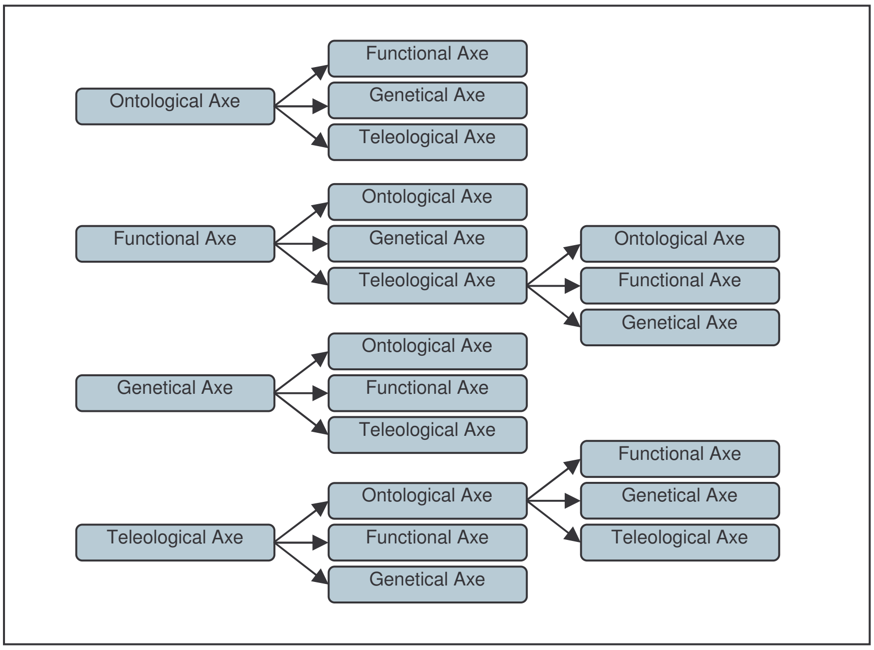

Figure 2 The epistemological axes

In order to create competitive advantages, the automotive industry needs to fit more realistically to the user needs. In this specific case we need a holistic approach. In fact, a multi-disciplinary approach combining perspectives from various sources and various research domains is used to gather together as many issues as possible that affect the older driver. A systemic methodology supports mastering the complexity and interrelations in the field and leads to the establishment of sustainable research results.
In this study we have considered the Aged Driver as our system and applied the system approach theory to map the information gathered in the EDAs (Etudes Détaillées d'Accidents = Detailed Accident Analysis) database consisting of more than 900 detailed descriptions of accidents. This database represents an instrument which has been developed to deepen knowledge in Accidentology and is used in this approach to structure the field.
In addition, and to include other perspective we have considered three more projection spaces:

- Driver-Vehicle-Environment System
- Information consistency
- Points of view

In a first step we analyse these elements within them according to the system and in a second step we consider these elements as a whole in order to identify interrelations between them, which will help us defining our research results. The following paragraphs give a detailed description of the methodology used.

3.1.2 The Driver-Vehicle-Environment system

Our approach is based on the "Driver-Vehicle-Environment System" DVE. Driver, vehicle and environment are in this approach considered as systemic components which have an influence on the driving task and stand in interrelation to each other. For the purpose of analysis all three factors are usually taken into account and reasoning is based on the interaction of these systemic components as illustrated in figure 4. This model is based on the research conducted by Walid Ben Ahmed. [21]

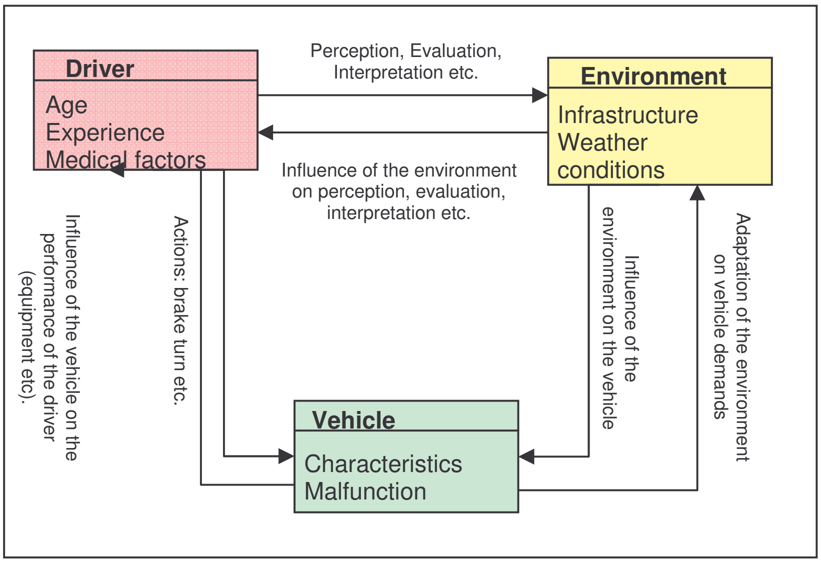

Figure 3 Driver-Vehicle-Environment Model (DVE)

Oxley and his colleagues from the Accident Research Centre at Monash University of Australia, concentrate analysing crash involvement and risk factors of older drivers from an environmental point of view [10]. An example for research where the focus lies more on the identification of factors that influence the potential risks of older drivers and thus concentrates more on the driver himself can be found in a study that has been published by Anu Siren and Liisa Hakamies-Blomqvist, dealing with demographic factors and mobility in Finnish men and women aged 65+. [11] A typical study focussing on the vehicle has been presented by Paul Herriotts [12] for the Design Department at Land Rover. His focus lies on the identification of design requirements for aged drivers.

3.1.3 The Information's consistency
A third element which we consider for our study of the system is the consistency of the information given. We distinguish between facts, hypothesises and statements which show uncertainty or fuzziness.

3.1.4 Points of view
Beside the DVE Model, the 4 axes and the analysis of the system's consistency we use an additional dimension to obtain our research results. As mentioned above we follow a multidisciplinary approach, which means that we analyse the system not only on different systemic perspectives but also from different points of view. Table 1 already gave an overview about some technical areas that we take into account. In the chosen case we have insights in the points of view of the driver, accidentologist, police, medical doctor, psychologist and witness.

3.2 Methodology
To apply the described model we use a database consisting of more than 900 detailed descriptions of accidents. This database called EDA (Etudes Détaillées d'Accidents) represents an instrument which has been developed to deepen knowledge in Accidentology. The cases support

- detecting new problems concerning road safety,
- formulate new hypothesises which can the be used for testing and experimenting,
- find out about interrelations between the different factors during an accident
- Give information about the system involved in the accident and understand its mechanisms which help setting new security standards and countermeasures [13].

In the Laboratory of Accident research, Biomechanics and human behaviour- LAB, brainstorming sessions are one of the means used to allow the communication between accidentologists and designers. The aim of these sessions is to understand the accident mechanisms and to propose new road safety countermeasures that designers may use as an input to elaborate new safety systems. However, there are many issues that have to be addressed in order to carry out successful brainstorming sessions:

- Designers and accidentologists do not share the same viewpoints, neither the same models to analyse an accident, nor the same technical language. For instance, a psychologist focuses more on the driver's information processing aspects whereas a designer is more interested in the mechanical aspects;
- There are many different approaches and viewpoints that can be used to analyse a road accident in order to understand the failure mechanisms. Some of these approaches focus on the accident's causal aspect. Others focus on the accident's sequential aspect [14, 15], or on the human mechanisms in error production and information processing [16, 17]. Some studies in cognitive psychology analyse the driver's behaviour as a process of skill learning and automation [18], or as a risk management process [19]. Thus, each of these approaches focuses on a specific aspect of the accident. However, when considering the complexity of the accident, several approaches should be combined in order to handle this complexity;
- Another difficulty that designers and accidentologists are facing when they work together is related to the nature and forms of the accident data. In the LAB, two expert teams perform on-site investigation to collect accident data. The collected information (e.g. driver age, infrastructure type, temperature, etc.) is combined with later investigation and stored in the accident databases EDA. The database we use contains 1300 road accidents and each accident is characterised by 947 attributes. Using the hundreds of accidents characterised by hundreds of attributes in a brainstorming session is a hard, time-consuming and thereby inefficient task.

From the operational perspective, we have mapped all the collected information into the four description spaces (System theory, View-points, Information Consistency and the DVE system).

3.3 Case study
For our analysis we considered different sources within the EDA database, related to accidents involving elderly as a driver, out of which we extracted components giving us information about the system's nature.

The data is usually summarised in a small abstract like the following, which we analysed first of all according to the different axes described under chapter 3.1. These summaries give us mainly information from the point of view of accidentologists but also reflect for example the medical point of view as they state whether a person has been injured or even killed:

CIRCONSTANCES EDA 288.
Renault 19/ Citroën CX

The accident happens on Saturday 5th of October 1996, around 17:15, at the intersection between RN13 and RD60 at Claville. Mr G., aged 81, driving on the RD60 in his Renault 19. He is joined by his wife on the front seat. At the intersection with the RN13, which is right-of-way sign, for an unexplainable reason Mr. G. crosses, although on his right a Citroën CX is approaching. The driver of the CX, Mr. L., declares driving about 100 km/h when he realises the Renault 19 moving towards the intersection, hesitating in the middle and then continuing. He reacts with a full brake application, leaving 57m of trace on the road before the crash. The front-seat passenger of the Citroën CX, wearing a seatbelt, is lightly injured. Mr L., wearing a seatbelt, is uninjured. No field sobriety test has been undertaken. The driver of the Renault 19 dies on the place of the accident, his wife is heavily injured. The driver of the CX and his little daughter are uninjured.

Beside this, we analysed interviews that have been conducted after the accident. Usually the researchers arrive at the same time as the police and start their work immediately. In some cases, especially if a person is under a shock or injured interviews are conducted in the hospital or at the person's homes. Interviews are recorded and transcribed which avoids that details get lost. In some of the cases a policeman, medical doctor or a psychologist intervene, which gives us the possibility to analyse their point of view as well. The following extract shows what kind of information these interviews give (EDA 260):

Accidentologist –which gear have you been using?
Driver - Ah well, as I stopped, I must have been in the first gear, because/ before I moved forward, I looked at the right and the left to see what is going on; before I moved on .

...
Policeman arrives:
P – Where do you have pain, Sir?
D - What?
P - Where does it hurt you?
D - Well, there on the side, if you see the car, you'll see ... the safety belt, of course I was wearing a safety belt but ... as it's not been in front... Well, it's been the side of the car which has ... there are no external injuries but...
P - Ok, but you will still go and be examined in hospital, don't you?
D - Apparently, eh... You know when you are under shock like this... Well, I was unable to move, eh, right after it happened in the car. But certainly some hours later, or the next day…
P – It's better to be examined. Do you have the documents of your car?
D – Ah well... I had my jacket on the/ I told them that I take it off; I had my jacket on the folder, there. (...) I came from Breteuil with; I've got some machines there, in Breteuil. I've been there with my boss, the manager, at that time.
P – I'll take your papers and you will go and be examined at the hospital (...)
D - ... I've got my driving license since more than 50 years, I didn't have any accident that I caused, you know. And I've been a member of the "Road Safety Department", I am still now.
....

As an additional element the cases sometimes give information about further circumstances like in this case about the driver's health conditions (EDA 239):

Health conditions:
Health problems: Tension (14 - 8). Cholesterol.
Treatments: Anelor. Caistran.

Glasses: Yes	*since: 4 years.*
	Default corrected: 1 for driving/ far sight &1 for reading.
Auditory problems: RAS.	
Size: 1 m 70	*Weight: 62 kg.*
Further preoccupations: « Everything fine ».	
Alcoholisation and its circumstances: No.	
Field sobriety test: Yes, Negative.	

Taking all these factors in account lead us to a complex system of information, which we documented in a way allowing us to interpret it from different perspectives. In fact as we considered 4 different factors to describe the nature of the system's components, we are now able to interpret them by analysing their interrelations which helps us to make statements about the system's nature. We analyses according to:

1. It's affiliation to the 4 axes (ontological, functional, genetical or teleological)
2. It's positioning in the model DVE (is the component related to driver, vehicle or environment?)
3. whether the information is a fact, a hypothesis or whether it is unsure
4. The point of view that played a role in the cases (Accidentology, Driver, Witness, Medical, Police or Psychology)

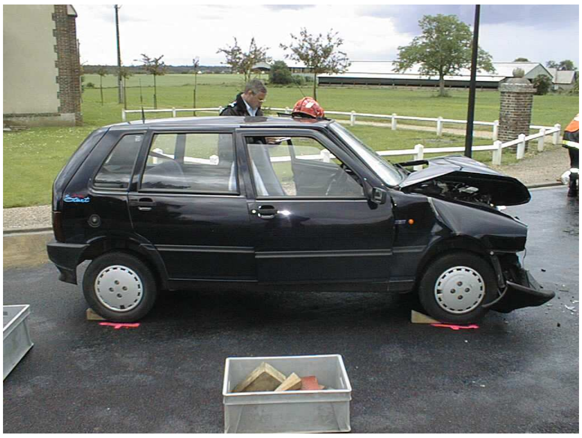

Figure 4 Picture representing vehicle and environment

4 RESULTS AND INTERPRETATIONS

An extensive interpretation of the projections, using the proposed model, led to the following preliminary set of major outcomes (see Table 2).

4.1 Driver-Environment

The first analysis provided is related to the nature of information provided by the driver when describing his environment. One can see that the knowledge gathered is mainly based on hypothesises, i.e. non verifiable. While only the objective of the driver is not covered. In the same time, the description by the driver of the environment constitutes the main input. There is certainly a need to build more consistent interview rules to gather more than this and especially capture the sequences of actions the driver conducted during the critical phases.

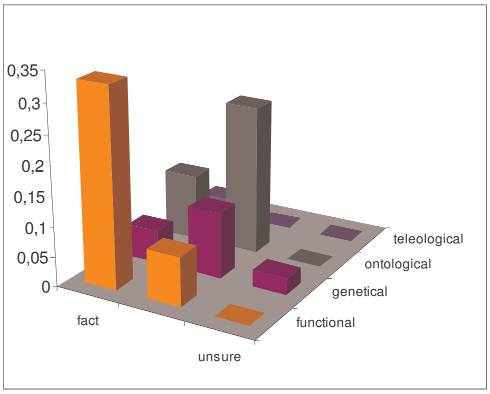

Figure 7 The viewpoint of the driver on its environment

4.2 Medicine-Driver

The analysis of the medical reports shows that this viewpoint completely excludes the understanding of the environment and the teleology of the driver. Almost all content is related to physiological aspects. Consequently, we can conclude that the EDAs do not constitute a satisfactory database from this perspective.

4.3 Driver-Driver

Making the driver talk about what he did during the period that covers the accident and the related circumstances is for sure a natural and obvious field to gather the maximum of information. However, this information is also disturbed by the fact that it's not verifiable. This characteristic has been already detected since a long within the EDAs and is used to justify the need for a black-box system to catch this information.

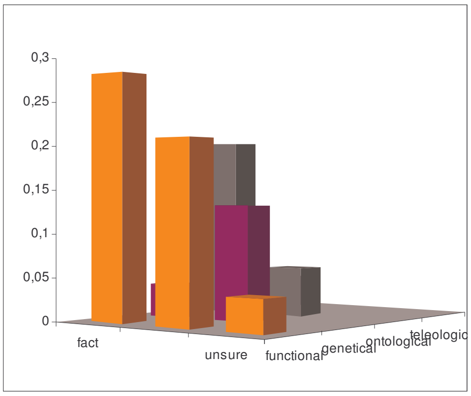

Figure 8 How the driver sees himself

4.4 Driver-Vehicle

In Figure 9, we report the result of a study on the nature of the knowledge we might capture from the driver regarding his vehicle, considering that, *a priori*; he is the main actor in the field. A deep analysis of this issue, reports that the requirements as set by the driver are not enough consistent and thus, might lead to undesirable effects.

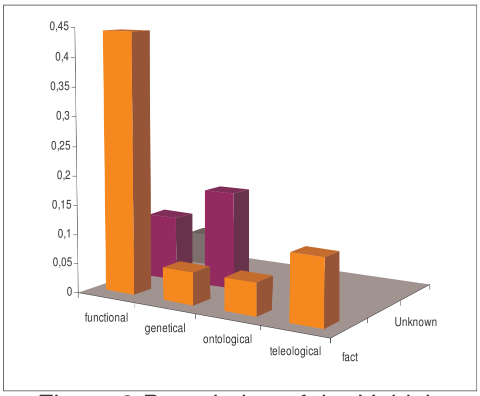

Figure 9 Description of the Vehicle by the Aged Driver

4.5 Accidentologist-Facts

From the accidentology point of view, one can notice that the capture of the evolution of the DVE system is not well reconstituted in the summary presented in the EDAs. It appears that the driver's perspective is not considered as crucial in the description of the process. On the other side, the accidentologist provides very strong factual description of the accident. The ontology of the system is his main focus.

In this specific study, the inputs from the accidentologist, even when we consider the older driver, is still of high level of value.

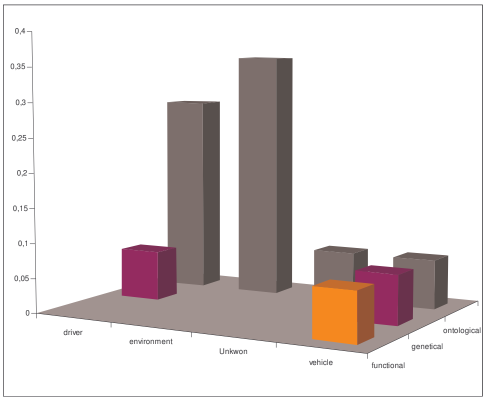

Figure 10 The accidentologist provides mainly facts on the Driver

Table 2. Summary of some outcomes

Point of view	ST-1	I.C	ST-2	DVE
Police	Describes	Facts		Driver
Witness	Describes	Hypothesis		Environment
Witness	Describes	Hypothesis		Driver
Medical	Describes	Facts		Driver
Accidentologist	If Ontological			Environment
Accidentologist	Describes	Hypothesis	Evolution	Driver
Accidentologist	Evolution			DVE
Accidentologist	Motivation	Describes		Driver
Accidentologist	Motivation	Neglects		Environment
Driver	Functional	Facts		Driver
Driver	Ontological	Hypothesis		Environment
Driver	Describes	Hypothesis		Vehicle
Driver	Evolution			Vehicle

Several levels of analysis can be considered in this study. Within the frame of this paper, we would like to highlight some facts related to the different points of view we considered.
First we realised that the witness does not describe the action of the driver in a proper way. He also mainly concentrates on the driver's environment (i.e. the movements of the other cars).
From the accidentologist's point of view, we can notice that he describes only motivation of the driver and not the motivation of its environment. The focus then is restricted.
Police and medicine base their view on facts whereas driver, witness and accidentologist also consider hypothesises. The motivation of the driver is only considered by the driver and the accidentologist. The other points of view consider rather the situation than the motivation.

If we take a closer look at the driver on a genetical point of view our statements are mainly based on hypothesises. If we go deeper into the analysis it becomes obvious that most statements taken from the case studies that are located on these systemic perspectives are related to the crucial situation during the accident. We can thus conclude that it makes sense to consider especially this level for further research as it can help us to identify those situations where our system, namely the older driver needs further support.

5 CONCLUSIONS

The present research study states the importance for interdisciplinary approaches in the field of aged drivers. Through our methodology we identified a variety of characteristics and interests according to the different points of view, which can help us developing a roadmap for the identification of car design requirements for older drivers.
Nevertheless the documented study shows that coherent results leading to the formulation of car design requirements for older drivers can not yet be made. We need an even larger picture of the system's components and prioritisation of the different actors in the field to get a critical mass of interdisciplinary aspects affecting the system. We are therefore working on the following aspects to enrich our model and deliver coherent research results aiming at the identification of car design requirements for older drivers:

- Extend the number of cases analysed in the EDA to get an even clearer picture about the information needed on the 4 different elements affecting our system
- Identify further research fields and technical areas interested in the system and involve them in the study e.g. by presenting them the cases and documenting their perspective on the developments
- Consider the genetic analysis of the driver in order to find out about his needs
- Identify further databases reflecting the points of view of different domains and alanyse them, using the developed methodology

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