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# PRESENTATION OF THE FIRST HUMANIST ANNUAL RESEARCHER EXCHANGE PROGRAMME.

## Report 1.2 of Task Force 1

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## 1. EXECUTIVE SUMMARY

Mobility of researchers is fundamental to success of the NoE. To make advances in such a complex field as ITS, teams of researchers from all parts of Europe need to be able to come together to exchange ideas and co-operate. This collaboration is essential to the objectives of the NoE.

Task Force 1 is intended to promote the development of human resources inside the NoE, which constitute the underlying raw material on which research capabilities are built. It also promotes the mobility of researchers between European countries and partners of the Humanist NoE.

This TF has four different areas of work to promote the mobility of researchers and students and implementation of the Network: PhD Grant, Post Doc Grants, Visits Between Partners and Reception of Students

The terms of the grants and exchanges have been defined and agreed between partners in the previous report "Report on the mobility requirements, rules and organisation" (deliverable 1.1 of the NoE).

Due to budget constraints, the first Joint Programme of Activities has chosen the first of them to start the mobility program. PhD Grants have been chosen as the first instrument mainly because three years will be required for the development and finish of the researches in time for the closing of the Commission grant of the NoE.

PhD Grants action is targeted at the training of researchers at the early stages of their research careers. It aims to contribute to a strong structuring effect on European research systems and to particularly encourage these researchers to continue to pursue a long term European research career.

The main steps of the process for the first Joint Programme of Activities are the following, as defined on the "Report on the mobility requirements, rules and organisation" (deliverable 1.1 of the NoE):

- The process was launch by July.
- Partners sent their PhD proposal to the Steering Committee (SC).
- The SC gave its approval.
- Partners published their PhD positions, nine has already been publish on Humanist Web and other webs.
- End of September - October the Candidates should have been chosen.
- The Grant goes from autumn 2004 till the end of 2007 (36 months).

Therefore, before the end of this year, nine partners (INRETS, FACTUM, CDV, CUT, EURISCO, TRL, UPM, UTL/FMH, IFADO) that finally will be hosting a PhD Grant, with all the implications and obligations with the Network that are explained in the "Report on the mobility requirements, rules and organisation" (deliverable 1.1 of the NoE).

## 2. INTRODUCTION

Mobility of researchers is fundamental to success of the NoE. To make advances in such a complex field as ITS, teams of researchers from all parts of Europe need to be able to come together to exchange ideas and co-operate. This collaboration is essential to the objectives of the NoE.

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This TF has four different areas of work to promote the mobility of researchers and students and implementation of the Network:

- PhD Grant
- Post Doc Grants
- Visits Between Partners
- Reception of Students

Two main categories of researchers will be part of the exchanges between partners:

- Early-stage researchers: This refers to researchers at the beginning of their research career with less than four years' active research experience (e.g. researchers undertaking a doctoral degree);
- Experienced researchers: This applies to researchers with more than four years of active research experience or those with a doctorate degree.

In the fields where important gaps in scientific knowledge and new relevant research issues will be identified, HUMANIST will foster and support international PhD proposals and joint PhD Direction.

In addition HUMANIST will sponsor the reception of students during their university studies by partners of the Consortium to contribute to their training as scientists in the fields of interest of the NoE.

The terms of the grants and exchanges have been defined and agreed between partners in the previous report "Report on the mobility requirements, rules and organisation" (deliverable 1.1 of the NoE).

### 3. METHODS

Due to budget constraints, the first Joint Programme of Activities has chosen the first of them to start the mobility program. PhD Grants have been chosen as the first instrument mainly because three years will be required for the development and finish of the researches in time for the closing of the Commission grant of the NoE.

PhD Grants action is targeted at the training of researchers at the early stages of their research careers. It aims to contribute to a strong structuring effect on European research systems and to particularly encourage these researchers to continue to pursue a long term European research career after performing his or her thesis in the framework of a strong European scientific partnership.

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- End of September - October the Candidates should have been chosen.
- The Grant goes from autumn 2004 till the end of 2007 (36 months).

The list of partners that have a PhD Grant initially allocated were:

	PhD Position
ERT	
INRETS	X
Bast	
FACTUM	X
CDV	
CUT	X
DTF	X
Eurisco	X
CERTH/HIT	
BIVV	
ICCS	X
EC – JRC	
NTUA	
SWOV	
TNO	
TOI	X
TRL	X
UPM	X
UTL/FMH	X
VTI	
VTT	
IFADO	X
Total	11

The list of partners that finally will host a PhD Grant are:

	PhD Position
ERT	
INRETS	X
Bast	
FACTUM	X
CDV	X
CUT	X
DTF	
Eurisco	X
CERTH/HIT	
BIVV	
ICCS	
EC – JRC	
NTUA	
SWOV	
TNO	
TOI	
TRL	X
UPM	X
UTL/FMH	X
VTI	
VTT	
IFADO	X
Total	9

Main modifications have been:

- CDV has changed from a Post Doc Grant to a PhD Grant
- DTF has changed from a PhD Grant to a Post-Doc Grant
- ICCS has changed from a PhD Grant to a Post Doc Grant
- TOI has changed from a PhD Grant to a Post Doc Grant

Therefore the final distribution will be:

	PhD Position	Post Doc Position
ERT		
INRETS	X	
Bast		X
FACTUM	X	
CDV	X	
CUT	X	
DTF		X
Eurisco	X	
CERTH/HIT		X
BIVV		X
ICCS		X
EC – JRC		X
NTUA		X
SWOV		X
TNO		X
TOI		X
TRL	X	
UPM	X	
UTL/FMH	X	
VTI		X
VTT		X
IFADO	X	
Total	9	12

## 4. REQUEST FOR A PhD GRANT FROM THE NoE HUMANIST

In the following, the PhD objectives of each partner are presented:

### 4.1 CDV

Proposed Research Topic for a Humanist PhD Grant:

**Subjective evaluation of assistance systems by the professional drivers.**

#### 4.1.1 *Objective.*

The Section for human and social problems in transport at CDV advertises the PhD grant with a duration of three years.

The main goal is to find out how the drivers evaluate intelligent transport systems (esp. ADAS) in vehicles, with special focus on information workload, distraction and feelings of comfort and safety. The study aims to contribute to the knowledge base about impacts of ITS on driver behaviour and the area of Human Machine Interface.

The aim of our research is to formulate a design for human-machine-interfaces between driver and intelligent transport systems providing information (ADAS, navigation systems...).

#### 4.1.2 *Background and Work.*

Modern in-vehicle information and communication devices are changing the nature of driving task. Drivers have to divide their attention between primary task of driving and secondary tasks like monitoring information displays.

Although the intelligent information systems have to reduce driver stress and increase his feeling of comfort, generally the safe driving, the question is, how is using of ITS evaluated in a subjective way. In another words, the subjective evaluation constitutes an important input to improve effectiveness, efficiency and usability of ergonomic design. The Human centred design is based on the user feedback, and so produces more improved design solutions.

Human-centred design should be evaluated by users needs:

understanding and specifying the context of use: the nature of the users, their needs and requirements, their goals and tasks, and the environment in which a product will be used  
specifying the needs in terms of effectiveness, efficiency and satisfaction

The study will particularly focus on the area of satisfaction (evaluating the systems if they work in a user-friendly manner and if they not increase stress and frustration). This will be surveyed by subjective evaluation by the drivers through the questionnaires developed in the beginning of the study.

The overall model of the joint cognitive system represented by the driver, vehicle and environment will be taken into the account.

To achieve this aim we need to know as much as we can about subjective evaluation of the in-vehicle systems by the driver. The question is, how these systems contribute to one's comfort and if and in which extent this systems can contribute to reducing driver's stress and mental workload, and what is their influence on fatigue.

We are planning to use a Dutch Questionnaire on the Experience and Assessment of Work (VBBA). This questionnaire is evaluating the psychosocial work environment (i.e. psychological job demands and job control), mental health and job attitudes. Besides this questionnaire we are planning to use other introspective methods (interviews) to achieving subjectively experienced feelings. Because we know that subjective methods are not able to be comprehensive, we also have to work with psycho physiological methods.

The research program will cover interviews and questionnaires, but also laboratory experiments. Our goal is to create a draft for recommendation for the decreasing of driver stress and increasing his feeling of comfort.

For this program we've chosen a group of professional transport (drivers in a public transport).

#### **4.1.3 PhD Grant.**

Duration: 36 months

The gross salary will be about 2000 euros per month.

A profile of the student:

- He/ she should be motivated to work in a multidisciplinary international research.
- Degree in psychology, medicine or engineering sciences
- Interested in ergonomics, cognitive psychology or human machine interface
- Advanced skills in written and verbal English are needful for the PhD grant.

## **4.2 CUT**

Proposed Research Topic for a Humanist PhD Grant:

### **Situation Awareness in the context of driving with ITS**

#### **4.2.1 Research background**

Intelligent Transportation Systems (ITS), such as In-Vehicle Information Systems (IVIS) and Advanced Driver Assistance Systems (ADAS) will change the driving task enormously. ITS aim at supporting the driver in the execution of the primary driving task and thereby positively influencing traffic safety. However, major concerns have been arising about the potential negative effects these systems may have on driving behaviour: from controlling to monitoring.

IVIS, providing the driver with information about his vehicle, the environment (e.g. meteorological, traffic and navigation information) and the world (e.g. advertisement, news, hotels near by) may visually or cognitively distract the driver from the primary driving task. Visual distraction occurs when the driver has to take away his eyes from the road scene to

deal with information presented visually inside the vehicle. The resulting impairments of driving performance and of object and event detection vary with the duration and frequencies of glances to the in-vehicle visual display of a system and its location. On the other hand, cognitive distraction occurs when processing of information provided by a system requires substantial mental resources of the driver (e.g. evaluating system output, deciding among a number of alternatives in a menu structure, planning the next step of action etc.). Vehicle control may remain unaffected, if the driver leaves his eyes on the road, but object and event detection may suffer.

ADAS not only present information to the driver, but also intervene in driving behaviour to a different degree. New ADAS technology more and more relieves the driver from different elements of the driving task, such as distance keeping, lane keeping, speed management etc. This ongoing automation of the driving task is consistent with automobile manufacturers vision of the fully autonomous car supposed to be realized within the next 20 years. The underlying assumption is that traffic safety can be enhanced by reducing human (driver) error. However, as research from other fields like the aviation domain shows, automation itself can have critical negative impacts on human performance. Thus, the intended effect of preventing the driver from overload by having numerous systems controlling different parts of the driving task may actually become the opposite. Because technical systems hardly function in 100 percent of all cases, they possibly fail in critical situations which may not be expected by the driver. In order to be able to intervene in such cases, to each time the driver has to be aware of his vehicle, the driving situation and the state of the in-vehicle systems. Thus, instead of having more spare capacities for „safe driving“, the driver now has to monitor that systems are functioning properly and to oversee functions which have been automated.

One term of growing significance in this regard is „Situation Awareness“. This theoretical concept originally stems from the aviation domain, where it refers to the moment-by-moment ability of the pilot and his crew to monitor and understand the state of the aircraft, its systems, and its environment (Adams, Tenney, & Pew, 1995). According to Endsley (1988), situation awareness is „the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning , and the projection of their status in the near future“ (p. 97). In the cockpit, a number of tasks usually simultaneously compete for the pilots attention. Current flight management technology aims to support the pilot in multiple-task management by regulating information presentation and controlling many functions previously assigned to aircrew. However, in the case of a possible system failure, the completeness and the currency of the pilot's situation awareness are critical to the ability to make decisions, revise plans and manage the aircraft. Thus, proper situation awareness is necessary for being better prepared to deal with upcoming events and to be protected from extreme surges of workload or breakdowns in information processing that are potentiated by unexpected circumstances (Adams, Tenney, & Pew, 1995).

In recent research, the concept of situation awareness has also been applied to road telematics. While driving with ITS, the driver's situation awareness may be impaired for a number of reasons. First, the driver may be visually or cognitively distracted by the interaction with these systems or by monitoring their state and behaviour. As the perception and interpretation of environmental information are fundamental aspects of achieving and maintaining situation awareness, distraction can cause the driver to overlook or to misinterpret important information. Second, partly autonomous driving is assumed to probably produce an underload of the driver in normal conditions. A low level

of situation awareness therefore may be the result of problems of vigilance or fatigue caused by having been cognitively and perceptually prepared for potential unforeseen events over a longer period of time. For example, it would be impossible to maintain the same level of attentiveness to possible system failures during a six hours drive on a motorway with ACC. Third, if the respective system most of the time is functioning properly (e.g. produces few false alarms or misses) and does rarely require attention, the driver may get used to it and gain confidence in its reliability. Then he might be less sensitive to relevant external information. Most dangerously in this regard is a potential rapid switch from underload to overload when the situation requires the driver to intervene in a timely and appropriate manner.

The major goal of the thesis is to investigate the influence of ITS on driver's situation awareness. The thesis will contribute to clarify how the transition from control to monitoring affects the primary driving task.

#### **4.2.2 Content of work**

The first step within the PhD thesis will be to review the concept of situation awareness and its applicability to the driving task from a theoretical point of view. As the driving task is assumed to differ in important dimensions from the flight task (e.g. in dynamics, in number of parallel tasks or information sources) it is not yet clear what situation awareness while driving exactly means (e.g. What are the relevant parameters of the situation model?) Thereby the focus will be on the processes involved in achieving and maintaining situation awareness (e.g. How is relevant information updated? Which kind of information is updated under time-sharing conditions? Which factors determine a good/bad situation awareness?). On the basis of this theoretical work, research will be carried out (simulator-based experiments or field studies) in order to investigate which components of situation awareness (perception, interpretation, anticipation) are affected by driving with ITS. Starting from this research implications will be drawn about how situation awareness can be supported by system design.

#### **4.2.3 Contributions expected for the NoE**

The work conducted within the PhD thesis is expected to have impacts on Task Force A, WP A.3 (Identification of the modifications in driver needs due to the implementation of new systems and services).

Contributions are also expected for Task Force B, WP B.2 (System evaluation and safety impact assessment from previous and on-going research), for Task Force C, WP C.3 (Development of ergonomic design criteria), for Task Force D, WP D.1 (Reviewing impacts of driver distraction due to the interaction with IVIS), and Task Force E, WP E.3 (Development of methods to investigate the driver appropriation processes of ITS functions at short-term (learning) and long term (adaptation) period of time).

#### **4.2.4 Partners involved**

Part of the work will be done in cooperation with TNO (The Netherlands), and with CDV (Czech Republic). Other partners will have to be defined.

#### 4.2.5 Profile of PhD Student

Master in psychology (maximum grade 1.4)

Education in experimental research and statistics

Education in engineering psychology, human-machine-interaction, human factors engineering, cognitive ergonomics

### 4.3 EURISCO INTERNATIONAL

Proposed Research Topic for a Humanist PhD Grant

**Impact of the use of advanced on-board systems on Driver's Behaviour: Analysis, Design and Evaluation Studies.**

#### 4.3.1 Research topic

The domain of the requested PhD grant is cognitive engineering. More specifically, this research work will be focused on the use and adaptation of cognitive sciences to the analysis, design and evaluation of human interaction with new on-board systems, which are highly-computerized complex dynamic systems. More specifically, applications will be taken in the automotive industry sector.

The field of the cognitive engineering concerns the analysis, design and the evaluation of human-machine systems where the computer plays a dominant role. Human factors are mainly cognitive even if sensory-motor processes need to be seriously taken into account in driving activities. We are definitively interested in the study of the use of cognitive systems in addition to the conventional driving activity (HUMANIST Task Force D).

Cognitive engineering mainly covers a field of investigation, which studies design and use of individual or collective interactive systems. Research effort will include analysis and modelling of driving activity and driver's behaviour. In addition, it will be focused on driver-centred design (HUMANIST Task Force C) as a process involving task and responsibility analysis that takes into account both internal (on-board systems) and external (environmental situations) contextual parameters. Human factors studies will include the development of user models, the investigation of new interaction modes and modalities (visual, vocal and gesture).

This research effort is also focused on driver's situation awareness from a safety-oriented perspective. We take a cognitive function approach to user modelling that considers agents as multi-agent entities and further emphasize agent-agent (humans and machines) interaction from both psychological and social perspectives. In addition, on-board systems are considered as cognitive systems that have themselves behaviours that need to be correctly understood in order to better improve road safety. A specific account will be taken on attention sharing among various involved functions and tasks according to driver's workload. Finally, we will study cognitive interference and risk taking by sometimes inverting the primary task of driving and other possible secondary tasks.

The thesis will also focus on new evaluation methods (HUMANIST Task Force E) based on cognitive models that will be developed. These methods will be used during evaluations

of the various prototypes that will be developed. During the integration of on-board systems in the vehicle, other evaluation methods will be developed and used.

#### **4.3.2 Application domain**

On-board systems that will be considered in this research work are taken in the automotive industry sector; more specifically, assistance systems in the management of energy (pollution effects), information (telematics and telephony), space (navigation, GPS) and speed.

For energy management, the driver is involved in an ecological driving task in order to decrease energy consumption and consequently pollution. Such on-board systems are likely to make emerge new driver's practices that we need to rationalize.

For information management, the driver is involved in various communication and information-processing activities. The driver typically speaks with passenger(s) or people external to the car via a telephone using the hands free kits for example. This kind of practice constantly evolves and infers new risks that are useful to identify.

For space management, the driver is involved in navigational activities. The driver uses navigation assistant systems in order to locate himself or herself, and find guidance suggestions. The use of such devices enables the modification of a planned trip at any time, and may involve new types of risks.

For speed (and time) management, the driver is involved in the optimisation of trip time by driving as fast as possible and satisfying safety constraints. The type of system that are developed to control speed are very similar to aircraft autopilots, and induce the same type of pilot behaviour (set point assignment, monitoring that the system is working fine, manual reversal, control of the environment, etc.).

On-board systems in cars are more numerous and inter-connected. They include more automation involving on various kinds of data including car, environment and driver data. The driver becomes a manager of these systems (or machine agents). Function allocation is an crucial issue that must be treated. In other words, it is today necessary for better to understand how cognitive functions are distributed among these systems (machine agents) and the human agents (including the driver, passengers, external people or vehicles in the environment). The driver needs to remain the boss (in charge) of these systems, and thus the levels of automation must be mastered and lead to the design of safe and reliable human-machine systems.

#### **4.3.3 State of the art**

Automation, even most simple automation, is an integrating part of our everyday environment. For historical reasons, automation was specifically investigated in aeronautics. Cockpit automation has been a topic of research in Europe (Boy, Hollnagell and Amalberti), and in the United States (Wiener and Billings).

Automation is not however always harmless. It needs to respond to precise requirements. Its functions and roles need to be well defined. Indeed, automation must not be considered as a gadget to be more harmful than effective. It performs functions which can help or in

certain cases considerably handicap the driver. Automation must be user-centred designed, and not limited to opportunistic implementations of available technical possibilities.

Wanner asks a fundamental question: "To what extent is it necessary to automate and which tasks is it necessary to automate?" Human reliability is typically a topic of interest in the control of complex dynamic systems.

In aeronautics, automation was often a solution to try to reduce human errors that may lead to accidents. This trend starts to develop in the automotive industry. Indeed the continuous increase of motor traffic leads to an increase of the risks of accident. That is why different driving-assistance mechanisms are being developed. However if these systems are not perfectly integrated, they are likely to become fatal (Amalberti, 1992). Automation introduced new types of human factors problems, a modification of role and competence in particular (Sheridan, 1984); the human operator goes from doing to thinking, from manipulation to supervision. The main issue is to anticipate the operator behaviour from the early stage of the design of an on-board system.

EURISCO has a strong experience in the field of automation in aeronautics that we will extend in this thesis to the field of automation in the automotive domain. On-board car electronics and data processing have recently developed and make emerge various kinds of new human-machine interfaces, e.g., electronic assistants for navigation or diagnosis. Consequently, numerous European research programs have been funded such as DRIVE and PROMETHEUS for example. Similarly, research programs were set up in Japan, e.g., the Advanced Cruise Assist Highway System Research Association, and in the United States, e.g., the Department of Intelligent Transportation Department Systems Joint Program Office.

Several authors underline the importance of performance-related and safety-related attention sharing both in flying and driving. Attention is a cognitive process that may be both related to perception and memory. Automation increases attention demands and sometimes diversion. It also has a direct influence on workload. For Wickens, Sandry and Vidulich (1983), a large number of complex systems are characterized by excessive workload in visual perception and manual response that end up in strong disturbances at the level of the main driving task. It is therefore necessary to design interaction means that are better appropriate to the driving task.

On-board telephony is a good example of this evolution. Pachiaudi (1996) analysed the risks of mobile phone use while driving, and pointed out many issues related to attention sharing between hand-set manipulation and driving. Nunes (2002) showed that the use of hands free kit solves a large part of these manipulation problems, but conversation-related problems remain and may have dangerous impacts on the driving task. Technological solutions to this kind of problem were developed such as within the European CEMVOCAS project (VOCAL CEntralized management of Interfaces aiming has Better Automotive Safety). This project investigated the development of a system capable of assisting the driver in the management of phone-calls according to driving requirements and events.

New information requirements motivate the development of new on-board systems. For example in September 2001, IFEN (French Institute for Environmental Issues) showed that

pollution produced by cars keeps growing. In this framework, EURISCO is currently collaborating in the design of an on-board system that will provide to the driver the state of vehicle energy, enabling a link among the driver, the vehicle and the environment. The driver will thus be informed on possible effects generated by his/her mobility and will be able to regulate his/her activity to better control vehicle consumption and pollution.

#### **4.3.4 Objectives and expected results**

The car is a machine being used to carry people from a location to another location. Today, several factors such as number of vehicles, density of traffic, variability of drivers, various levels of driver behaviour, greater needs for safety, comfort, information and communication have made emerge new practices.

New technology is currently developed to tackle these issues. It results from people expectations, requirements and even sometimes fashion. It is important and useful to study this evolution from the point of view of cognitive engineering, that is to elicit cognitive functions involved in new driving tasks in order to better design and integrate appropriate on-board systems.

This research effort will be carried out within a industry/research cooperative framework. It will be focused on the currently developed on-board systems. It will be grounded in both cognitive research and operational requirements.

This thesis should extend the general approach of human-centred design by bringing new methods for an improve design of on-board systems. It will be focused on various concepts such as attention sharing, responsibility sharing and information transfer among human actors and machines. We think indeed that the integration of on-board systems must be mastered to foster safety and user comfort.

#### **4.3.5 Scientific approach**

Driver's cognitive functions will be elicited and modelled by using a scenario-based approach. Modelling is expected to help to identify the sources of workload variation and the links between these various sources. It will enable us to better analyse cognitive processes used by the driver in driving tasks and the manipulation of various on-board systems. The driving task involves various kinds of intermodality such as visual, auditory and manual. The use of an on-board system introduced by new sensori-motor data into the cockpit and consequently modifies the classical driving task. Modelling is expected to provide better understanding of these driver activities.

It is intended to analyse typical behavioural data as well as driving activity and situations of driving to design more appropriate human-machine systems. Tests will be set up in both simulated and real driving environments to perform formative evaluations. Eye tracking may be used to better analyse drivers' behaviour and activity, and provide more appropriate design solutions.

Information provision and management in the cockpit are crucial processes that need to be studied to improve comfort and safety. They should result from a deeper analysis of driver behaviour in such environment. We will study appropriate technologies that supply

contextual information. Therefore, context (environment, vehicle and driver states) will be one of the major concerns in this thesis, and especially context modelling.

#### **4.3.6 Experimental means**

The PhD student will have access to means privileged by International EURISCO. In particular, EURISCO will provide the PhD student with an access to means of simulation and an instrumented vehicle. Furthermore, EURISCO's eyes tracking means may be used. EURISCO's relations with the city of Toulouse and community of the Toulouse district will enable the PhD student to have an instrumented urban zone allowing the collection of data. EURISCO's knowledge in aeronautics and human-centred automation will be provided.

#### **4.3.7 Supervision**

The PhD thesis will be performed in cooperation with the University of Lisbon, UTL-FMH. Activities will be performed at both locations. Practical activities and experimentation will be performed mostly at EURISCO, theory-oriented activities mostly at the university of Lisbon. The thesis will be co-supervised by both institutes.

#### **4.3.8 Co-supervisors**

Guy Boy, President and Chief Scientist of the European Institute of Cognitive Sciences and Engineering (EURISCO International).

Anabela Simoes, Associate Professor, Department of Ergonomics, Technical University of Lisbon (FMH).

#### **4.3.9 Bibliography**

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## 4.4 FACTUM

Proposed Research Topic for a Humanist PhD Grant:

**“Effect of IST applications on the communication between road users in urban areas”**

### 4.4.1 *Research topic*

“Speed adaptation via in-car devices has been studied for over 15 years. Estimates of the safety effect of a fully implemented automatic speed management system in Sweden and the UK vary from a 10 percent reduction in injury accidents with an advisory system to a reduction in the range of 20-40 percent with a system that enforces current speed limits and also limits the speed in critical conditions (slippery road, poor visibility) (Várhelyi 1996; Carsten and Comte 1997, Carsten and Fowkes 2000). Earlier field trials (Persson et al. 1993; Almqvist and Nygård 1997; Várhelyi and Mäkinen 1998) and simulator experiments (Comte 1996; Comte 1998a; Comte 1998b) have demonstrated the positive effects of the “intelligent” gas pedal.” (Várhelyi et al. 2002)

In these studies around ISA (Intelligent Speed Adaptation) everything also points to the fact, that speed reduction of vehicles affects communication between road users. Car drivers for instance yielded more often for pedestrians, and pedestrians were less often forced to stop under conditions of reduced speed. There also exists empirical evidence for a modified visual behaviour under different speed conditions. When driving at higher speeds the focus of human vision tends to be more distant, and thereby peripheric vision in the vicinity deteriorates. At a lower speed the focus is more on the near-by environment and peripheric vision is more efficient, which facilitates the registration of and communication with pedestrians. The question of communication seems generally of high importance against the background of the fact that 75 % of accidents take place between two or more road users. It can be assumed that those 75% represent a breakdown of communication. At the same time, it is known that ISA application has the potential improve communication due to better adapted speed of the drivers.

Within this master thesis the modification of communication between car drivers and other car drivers viz. other groups of road users that is caused by, or detected in connection with, the use of ISA should be investigated. Therefore an in car observation based on the principle of registration of critical incidents is planned.

From the planned observations one can expect to learn under which conditions communication works well, and when it does not. At this point, a connection to HUMANIST TFF (Driver education and training for IST use) and/or to TF5 (Training programmes) can be identified. For TFF it will be useful to gather information about communication between road users and how it could be enhanced. This knowledge can be used in TF5, in connection with the education of young researchers.

Summarisingly, this master thesis deals with the influence of ISA on the communication between car drivers and other road users, and with the adherent question how the gained knowledge can be used both in the education of drivers and of young researchers.

#### 4.4.2 Organisationally.

Hosting institution:	FACTUM
Tutor:	Ralf Risser
Partner – University:	University of Vienna
Tutor:	Prof. Anton Amann
Partner - HUMANIST:	CDV
Tutor:	Karel Schmeidler
Contribution expected:	Literature on request Expertise on request

#### 4.4.3 PhD Grant.

Financial:	29.496 € every 12 month Covering of possible extra costs
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### 4.5 IFADO

Proposed Research Topic for a Humanist PhD Grant:

**Psychophysiological measurement of mental load induced by information provided by driver assistance systems**

#### 4.5.1 Concept for the research program.

The project group Cognitive Neurophysiology of the Institute for Occupational Physiology at the University of Dortmund advertises a Ph. D. grant with a duration of three years. Main objective of the program is the application of psychophysiological methods to the measurement of the type and degree of driver workload induced by additional information provided by driver assistance systems. The aim of the research is the formulation of scientifically well-founded guidelines for the design of human-machine-interfaces between drivers and new in-vehicle and roadside systems providing additional information (e. g. navigation systems, variable message signs etc.).

The human-centred design of the human-machine-interface between drivers and driver assistance systems requires the precise measurement of the mental workload induced by additional information. In order to prevent negative effects on road safety by driver distraction from the primary driving task or information overload, secondary information must be presented in a way that should meet the requirements of human information processing. Improvement of information presentation needs both the quantitative measurement of workload increases due to a particular method of information presentation and the diagnostic identification of the type or source of mental workload (e. g. in terms of the information processing stage involved).

In the context of the theory of multiple information processing resources an indicator is diagnostic, if it determines the type of workload and the degree of workload increase.

Introspective reports (questionnaires, interviews etc.) about subjectively experienced changes in workload allow, on the one hand, to draw conclusions about the amount of subjective change in workload. On the other hand, subjective measures are not able to identify the type of resource involved (sensory, cognitive, pre-motor etc.). Behavioural measures like reaction times or dual-task measures etc. have in contrast a greater diagnostic power for the identification of the type of workload. However, the valid measurement of workload changes in low and high workload regions is hardly possible with such measures, because workload variations in these regions do not necessarily cause corresponding changes at the behavioural level.

Psychophysiological methods offer in comparison objective and non-intrusive possibilities, both for the diagnostic specification of the type of workload involved and the measurement of workload increases. Event-Related Potentials (ERPs), extracted from the electroencephalogram via averaging techniques, enable to examine the specific involvement of different stages of information processing. Latency and amplitude of ERP-components indicate temporal characteristics and the degree of activity of the process in question. The topography of the components allows further conclusions about the neuronal structures involved in information processing. Different ERP-components reflect the activity of different information processing stages: preparation of cognitive processes, early processes of stimulus detection and allocation of attention, processes of inhibition of irrelevant stimuli and suppression of responses, spatial attention processes, stimulus identification, response selection and different characteristics of error processing.

Until now, driver workload changes due to additional information by driver assistance systems have not been measured with psychophysiological methods at this fine-grained level. The objective of the granted Ph. D. program is therefore the analysis of the effects of additional information on information extraction and processing using ERP-components as indicators. Hence, the main aim is to examine if, and to what extent, different ways to present secondary information tie up sensory, cognitive and / or premotor resources which are at the same time relevant for the primary driving task.

The research program will start with laboratory experiments to assess different information presentation forms (e. g. auditory vs. visual presentation) and associated cognitive tasks (e. g. inhibition of irrelevant information) with ERP-indicators and reaction time as behavioural measure. Based on the results, preliminary design recommendations for the reduction of driver workload will be formulated. The validity of the design recommendations will be further evaluated both using computer-based analogies of the driving task (tracking tasks, driving simulation) and in field studies in real traffic with mobile recording of the ERPs. A main area of the research program will be the development of age-differentiated design recommendations, because the speed, accuracy and co-ordination of cognitive processes decreases on average in older adults.

#### **4.5.2 PhD Grant.**

The Ph. D. grant has a duration of 36 months. It is advertised by the Institute for Occupational Physiology at the University of Dortmund in Germany ([www.ifado.de](http://www.ifado.de)) in the framework of the European Network of Excellence Human-Centred Design for Information Society Technologies (<http://www.noehumanist.org>). Promoter of the Ph. D. program will be PD Dr. Falkenstein, head of the project group Cognitive Neurophysiology at IfADo. The grant includes a mandatory stay of in total six months with one of the international project partners. For this purpose an exchange program is planned with the Transport Research

Centre (Centrum dopravního výzkumu, CDV) of the Czech Ministry for Transport and Communication.

Applicants should be motivated to work in a multidisciplinary international research group. In addition to a university degree in psychology, medicine or engineering sciences the applicant should have knowledge about one or more of the following areas:

- Psychophysiology
- Cognitive Psychology
- Ergonomics
- Transportation

Knowledge and experience in the design, execution and analysis of experimental studies are expected. Advanced skills in written and verbal English are a prerequisite for the Ph. D. grant. The gross salary will be ca. 2000 € per month. Social security and insurance contributions will be extracted. Additional budgets will be available for travel costs and the international exchange program.

## 4.6 INRETS

Proposed Research Topic for a Humanist PhD Grant:

**Driver behaviour modelling and cognitive engineering tools development in order to assess driver's situation awareness**

### 4.6.1 *Context*

This PhD proposal is focused on drivers' situation awareness study, with the aim to assess it from drivers' behaviours. Synthetically, driver's activity is not directly based on the objective state of the world, but on a mental model of the road environment. This mental representation is built in working memory from perceptive information, on one side, and from driving knowledge (stored in the long term memory), on the other side [1]. It provides a functional and self-oriented interpretation of the reality, including anticipations of potential evolutions of the current driving situation. Indeed, it corresponds to the driver's situation awareness, according to Endsley [2] definition of this concept (i.e. the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future). Moreover, this mental model is "action oriented" (i.e. the driver doesn't observe the road scene as a "spectator", but as an "actor") and includes goals, required actions to reach these goals, expectations concerning driving actions effect, and so on [3]. Once built, mental representations generate perceptive expectations, guide the road environment exploration and the new information processing, orient decision making... and, at last, determine behaviours carried out by the driver. Consequently, mental model and/or situation awareness is a key element of the driver's cognition ; and an erroneous representation means, potentially, decision-making errors and unsafe driving actions. From this point of view, it is a crucial question for driving assistance design in order (1) to understand human errors, (2) to identify driving difficulties and drivers' needs, and (3) to determine which type of help is more particularly adapted in a given driving context.

### 4.6.2 Objective

This PhD Proposal is in the field of “Cognitive Sciences” including, on the one hand, Human Sciences models (coming from Cognitive Psychology and Ergonomics) and, on the other one hand, Computational Sciences and Artificial Intelligence techniques for Cognitive Engineering. The global objective of the research is to define a framework for driving behaviour analysis (e.g. driver’s actions on controls, visual strategies, etc) according to the current driving context (e.g. road infrastructure characteristics, event occurrences, traffic conditions). More precisely, the aim is to develop models, methods and Cognitive Engineering tools for “ecological” data processing, in order to infer driver’s situation awareness from driving activity “traces”.

Concerning the driving situations considered, the research could be more particularly focused on intersections crossing, with the aim to model driving activity and assess drivers’ situation awareness, according to road infrastructure characteristics and traffic conditions.

Concerning drivers behaviour modelling, the research will use the “Driving Frame” approach defined at INRETS-LESCOT for driving knowledge modelling and computational simulation of mental models. The research will aim to define methods and computational tools in order to infer driving frames from objective data including (1) driver’s behaviours, (2) vehicle state, and (3) traffic conditions. From this last aspect, this research is clearly consistent with the DVE “integrated model” approach.

Concerning Artificial Intelligence and Cognitive Engineering tools, the research will use the MUNETTE (Modelling USEs and Tasks for Tracing Experience [4]) model developed at LIRIS1, which is INRETS-LESCOT University partner in this domain.

From a practical point of view, PhD student will be in charge (1) to collect ecological data in real driving conditions with the INRETS experimental car, (2) to model drivers behaviours and driving situations via MUNETTE methods and concepts, and (3) to develop cognitive engineering tools for drivers activity analysis and situation awareness assessment. At this level, this work will constitute a first step towards User Centred Design tools, with the aim to identify assistance needs, according to driving conditions and human activity.

#### Key-Words:

Drivers Behaviour Modelling, Mental Model and Situation Awareness, Ecological Data Collection and Processing, Methods and Tools for Behaviour Analysis, Cognitive Engineering.

### 4.6.3 Partnership

The main part of PhD will be done at INRETS-LESCOT (Bron - France), but stay(s) with other(s) Humanist partner(s) as IFADO or CUT will be strongly encouraged in order to exchange knowledge, experience or methods. The first year of the PhD will aim to identify partner(s) in Humanist Consortium interested in working with us in this domain. This research will also obviously involve the LIRIS laboratory (CNRS/University Lyon1), more

<sup>1</sup> LIRIS: *Laboratoire d'InfoRmatique en Images et Systèmes d'information*; CNRS FRE 2672 / Université Claude Bernard Lyon1. <http://liris.cnrs.fr>

particularly for Computational Sciences and Cognitive Engineering aspects on situation awareness.

#### **4.6.4 Student profile required**

Pluri-disciplinary formation in Cognitive Psychology/Ergonomics and Computational Sciences is required. English language is required, and French is wished.

#### **4.6.5 Main contributions of the PhD to HUMANIST NoE**

A framework for modelling driving behaviour based on the DVE approach.

A set of ecological data collected in real driving conditions.

Specific methods & cognitive engineering tools for data processing, behaviour analysis, and situation awareness assessment.

#### **4.6.6 Equipment required:**

All required equipments for this research are currently available at INRETS-LESCOT. Nevertheless, Humanist partner(s) experimental car(s) could also be used in order to collect data in other state(s).

#### **4.6.7 References**

- [1] Bellet, T., Tattegrain-Veste, H. (2003). COSMODRIVE : un modèle de simulation cognitive du conducteur automobile. In JC Spérandio & M. Wolf (sous la direction de), Formalismes de modélisation pour l'analyse du travail et l'ergonomie, Paris, Presses Universitaires de France, p. 77-110.
- [2] Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. Human Factors, 37 (1), pp. 32-64.
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### **4.7 TRL**

Proposed Research Topic for a Humanist PhD Grant:

**Assessing the visual and other demands (distraction potential) of Nomadic Devices within passenger cars and delivery vehicles.**

#### **4.7.1 Introduction**

TRL would like to apply for a PhD grant within the Humanist Network of Excellence as described in the Report on the Mobility Requirements, Rules and Organisation produced by Task Force 1.

This application comprises a brief definition of the area of the PhD work, the partners involved inside and outside Humanist, a profile of the student to be sought and the contribution to the Humanist NoE.

#### **4.7.2 A Brief Definition of the PhD project**

##### Background/Motivation

The widespread introduction of advanced computers and communications-based personal products is leading to an increased expectation of “always-on” communication and access to information. This is also extending to the in-car environment where users (now drivers) expect the same access even when mobile.

The provision of systems to meet these consumer demands within vehicles has led to systems within cars that provide a range of applications, both driving-related (e.g. navigation, travel and traffic information, collision warnings, alertness and monitoring) and non-driving related (e.g. voice communications email, entertainment). However, the rapid pace of technological development means that personal mobile systems that are available to the user in all environments (both inside and outside the vehicle) will offer more features and will be more transferable to other activities.

At the same time, the commercial advantages of information technology and communications are being realised and implemented by commercial fleets. Custom-solutions are one option, but the use of generic devices, sometimes with custom software, can offer a more cost-effective route for smaller organisations.

These trends have led to the rapid growth and use of “nomadic devices” within vehicles i.e. devices that can be rapidly and easily removed and used outside of the vehicle environment. Such devices are usually generic and can perform a number of functions depending on software. For example, a PDA can be configured for dispatch and stock control, route guidance or as a personal message centre.

Clearly, there is a danger that drivers of the future will be overwhelmed by devices that are not well-designed and not well-integrated into their vehicles. This is even more the case when devices have been designed to be a primary or only task rather than a secondary task shared with vehicle control.

#### **4.7.3 Description of Work**

This PhD will contribute to a methodology for assessing the visual and other demands (distraction potential) of Nomadic Devices within passenger cars and delivery vehicles by tackling two important but not well-understood issues:

##### a) Reference model of driver interaction

One of the greatest sources of variability in human performance measurement is individual differences between participants. This work will seek to better understand how different driver characteristics contribute to differences in the driver interaction parameters usually assessed. For example, age is a commonly recorded factor that is actually a “surrogate” for a wide range of human characteristics. By understanding the interaction of visual, cognitive and manual factors and factors such as driving experience, attitudes etc., the

work will build up a fuller picture of the important driver characteristics that affect outcomes in human performance trials.

#### b) Reference interfaces

A second focus will be the investigation and use of “reference interfaces” as a means of comparing distraction. This approach has been used within European projects (including HARDIE, HASTE and ADAM) although the theoretical basis for task choice needs further work and justification. Reference interfaces are a pre-defined interface that the driver can use for one or more tasks. These tasks are standardised such that they have the same level of difficulty and are used by all participants for control and calibration purposes between trials.

The advantage of one or a small number of reference interfaces is that practical comparisons of the distraction potential of different devices can be made with different participants at different sites using different test methods. However, for this to be robust, a good theoretical model relating tasks and driving behaviour needs to be developed and validated, at least in the limited domain of the dual task paradigm.

#### **4.7.4 Expected Outcomes**

The work on driver characteristics will contribute to development of a ‘reference model’ of typical driving behaviour which can then be used as the reference case in simulator trials (or in real road observational studies). It will contribute to practical issues of participant screening, recording of participant characteristics and development of instructions for participants in trials.

The work will also lead to a deeper understanding of driver interaction with nomadic devices and the elements within a reference task that need to be present to fully represent real-world nomadic devices. This will, in turn, provide a good foundation from which one or a small number of reference tasks can be defined for inter-site comparison of distraction.

In contrast with resource-intensive methods, such as road trials to measure vehicle-parameters, the approach adopted will be practical and aim to incorporate the use of driving simulators (of different fidelity) as well as part-task simulation and measurement techniques including Occlusion and the Lane Change Test developed in previous projects.

#### **4.7.5 Partners Involved**

TRL (UK Humanist Partner)

Loughborough University (UK Academic Partner – not Humanist)

CDV (Humanist Partner)

#### **4.7.6 Student Profile**

Applicants should have a good first degree in psychology, human factors/ergonomics, or computer science (with a strong HCI component). Flexibility and a motivation to work collaboratively will be as important as individual working ability. As a PhD supported by a European Network of Excellence a European perspective is encouraged. The student will be based at TRL in Wokingham but spend up to half of his/her UK time at Loughborough

University. The student will also spend about 6 months with partner organisations of Humanist including CDV in the Czech Republic and be expected to participate in Humanist meetings, training and presentations throughout Europe.

The successful candidate will receive an annual salary with expenses for travel and subsistence during visits. UK tuition fees will be paid by the grant.

#### **4.7.7 Contribution to NoE**

This PhD is relevant to the technical work areas of TF D (Impact analysis of ITS on driving behaviour) and TF E (Innovative methodologies to evaluate ITS safety and usability)

It will add to knowledge concerning driver distraction from a theoretical and practical point of view and this should lead to the development of one or more new approaches to the quantification and comparison of distraction potential. This will contribute to the debate over safety of in-vehicle interfaces and has the potential to support policy decisions on allowable levels of visual demand while driving.

In terms of the Network, the PhD student will fully contribute to the NoE objectives of closer integration between organisations and the emergence of a more European view of research needs and delivery of research.

### **4.8 UPM**

Proposed Research Topic for a Humanist PhD Grant:

**Use and effects of video technology for enforcement and monitoring applications in ITS**

#### **4.8.1 Introduction**

Digital imaging techniques, using video camera technology, offers one potential solution to achieve compliance with laws, rules and regulations in a both cost- and resource- effective way in the transport area. The proposed PhD Thesis aims to demonstrate the feasibility of identifying the vehicles present on the road by capturing an image of their number plate as if it were a personal identity card, and also to evaluate the acceptance of such measure and to assess its effects. The challenge seems to be the validation of video images as legal evidence overcoming the general fear in the public opinion, due in part to the uncertain interpretation of the characters of the plate in case of low quality pictures, to the possibility of manipulation of the data related to it, and to the specific recommendation of the Privacy Principles against information gathered by advanced video technologies [8], [9]. The restrictions imposed by International and European regulations on the collecting, storage, processing and dissemination of data relating to individual and their behaviour also restrain the promotion of the acceptance of digital video as evidence in court.

In fact, the development of Video Enforcement Systems (VES) is closely related to the implantation of Intelligent Transport Systems (ITS) applications. As Automatic Enforcement (AE) systems in which VES are based use many of the same technologies as ITS, and thanks to the increasing cooperation between ITS operations and law enforcement, it can be said that the potential for AE and ITS to be linked in the public's perception exists. However, the new linkage between AE and ITS needs that the ITS

community rethink the privacy issue. Therefore, AE advocates must make clear that the public is gaining in return [9]. In broad terms, we can say that the most significant ITS applications in relation with enforcement can be divided in three main areas: urban, interurban and road pricing [3].

Concerning this matter, it is worth mentioning Project VERA (Video Enforcement for Road Authorities) [1], [2] whose overall mission is to examine harmonised approaches to the enforcement of traffic laws using video technology. Its members, in a first stage of the project, worked hard on the development of VES in some enforcement applications identified in ITS, such as: traffic signal, bus lane, speed control, tolling, and weight in motion [4]. In spite of being aware of the necessity of taking into account psychological aspects in order to define the technical designs that fit best the service demanded in each site, VERA Project did not consider in its evaluation guidelines how to satisfy the users, but the governments, enforcement bodies, and companies related with transport. So their main issue does not involve trying to train the drivers, neither to impel them to contribute to the safety of the traffic systems, but punishing and charging them. To sum up, the operators who implement the VES in VERA are the police or other authorities, and the drivers are merely considered as the potential “victims” of those systems.

Nowadays, the major issues of VERA II [5] are to establish a legal framework for cross-border enforcement in Europe where cross-border traffic continues to increase every year.

On the other hand, ESCAPE Project [6] considers a wider range of opinions towards new enforcement concepts examining the attitudes of various agencies, but their aim only reaches at obtaining qualitative information from a small number of ‘opinion-leaders’ in four European countries.

Besides, HUMANIST Project [7] is planning to organize interviews, surveys and group discussions for the analysis of user needs and requirements in several areas of ITS in order to achieve user and social acceptance. Each class of users has a different perception and a different need with regard to video enforcement and that should be learnt at different points of the development process. It is an issue that should be taken into account because very often drivers’ behaviour aims to lay bare their disappointment when the improvement demanded is not answered. Users are not attracted to anything they have to pay for and they do not like feeling watched over by enforcement bodies, but their subversive behaviour is increased when they do not get anything on return. Then, even if VES security can put a crimp in drivers’ use of the traffic systems by making clear in their own mind that there is no way to cheat the enforcement application thanks to the robustness of the system, the true path to contentment for all the parties lies in meeting anyone’s requirements as long as it is possible. So, identifying needs through subjective methods is an issue of the utmost importance, as it makes much more efficient the task of design of the road cameras as well as the definition of a technical criteria to guarantee the reliability of an image based on quality parameters as to be validated as an identification of the vehicles.

#### **4.8.2 Objective:**

Taking into account all the previous information, the main objective of the research work is to try to define the framework of Video Enforcement Systems from three different points of view:

Technical, by defining the basic architecture of the system that would allow the usage of the image information to prosecute violators (concerning tolling, speed limit, traffic lights, etc) under robust performance parameters, regarding efficiency, precision, quality of the acquired images, and security.

Legal, by establishing the required elements in the basic architecture that would guarantee the usage under privacy restrictions and integrity, so that image records can be admissible as evidence in court.

Psychological, by evaluating the acceptance and effects of the VES systems in driving behaviour, at different environments (urban traffic, interurban traffic, highways), and different types of offences (tolling, speeding, red light running, etc). This information is considered essential, and it will be used to feed-back the two previous aspects (technical and legal). Public education and awareness of automatic enforcement activities is a critical element of nearly all successful automated enforcement systems [8]. It would be quite interesting to have some pre samples from the locations before the technology is implemented and then compare them with a post sample after the VES systems are in operation.

#### **4.8.3 Required student profile**

The student should have a pluri-disciplinary profile, including Engineering level, plus some formation in Psychology/Ergonomics. English language is required, and Spanish is appreciated.

#### **4.8.4 Humanist Task Force concerned**

Task Force D – Impact analysis of ITS on driving behaviour.

#### **4.8.5 Contributions of the PhD to HUMANIST NoE**

An assessment of Video Enforcement Systems acceptance and usability.

A set of collected data showing the effect of the VES systems. Taking into account that these systems are currently starting to be installed in Spain, the research work will try to have pre-sample and post-sample data, before and after VES systems are installed.

#### **4.8.6 Partnership**

The PhD will be performed in collaboration with at least another partner from Humanist. Currently, there are some contacts with some institutions which have already shown interest to collaborate.

#### **4.8.7 Bibliography**

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- [2] VERA Project. (Video Enforcement for Road Authorities). Deliverable 4.1, Synopsis of Video Enforcement Systems and Applications. September 1998.

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## 4.9 UTL

Proposed Research Topic for a Humanist PhD Grant:

### **In-Vehicle Information and Communication Systems and Driver Behaviour: Analysis and Evaluation**

#### **4.9.1 Research Topic**

The development of the new technologies of information and communication is changing the uses and the practices in transport. Together with the increasing complexity of road environment and traffic density, the emergence of these in-vehicle systems introduces changes into the driving task, giving rise to new problems to road safety as they affect the driver ability to process the amount of information required to make adequate driving decisions in a useful time. Although the interfaces of the existing systems have been developed complying with human factors and ergonomic design guidelines, the human-machine interaction, as well as their joint integration in the vehicle require more research addressing the driver's mental workload and attention availability to perform safely multiple tasks in driving situations at different levels of complexity.

The study of the driver cognitive activity while interacting with any in-vehicle information system (IVIS) is essential for the road safety improvement as it allows:

- To understand the driver behaviour,
- To create a knowledge basis to guide the systems design and integration,
- To define conditions and priorities for the safe use of each system.

The human variability among drivers, particularly in terms of age and experience, is another major concern in this context. Moreover, age-related perceptive and cognitive declines could have negative effects on the driving task performance, but older drivers

develop some compensatory strategies based on previous experience. However, the above-referred changes in the driving task, resulting from the interaction with IVIS, could inhibit any compensatory behaviour due to the lack of previous experience. Being the number of older drivers significantly increasing, any study in this field should integrate a sample of drivers being 60 years old and over.

The amount of visual information, coming from a complex and dynamic environment and from in-vehicle visual displays could conflict with the driver cognitive resources to process it correctly and safely in a useful time. Therefore, the study of visual strategies in selecting and gathering the relevant information is crucial in this study.

Auditory inputs from IVIS could be useful but they could as well have a negative impact on driving. Actually, a too big flow of vocal information exchanged with the driver increase the driver mental workload as it represents an additional task that could use resources allocated and necessary to drive safely. In this case, the interaction with IVIS should be subjected to a definition of priorities according to traffic conditions and the relevance of the information to the driving task.

Therefore, this research will be centred on the study of the impact of multiple visual and auditory inputs from IVIS on the driver behaviour by means of assessing the driver mental workload while interacting with the systems in different categories of roadway configuration and traffic density. Age-related differences in the driving task performance based on the driver cognitive resources for information processing and decision-making are taken into consideration in the project. For this purpose, the sample will be selected according to two categories of age: up to 40 years old and 60 and over.

#### **4.9.2 Application Domain**

The scientific domain of the requested PhD grant is cognitive science applied to a transport context, particularly the situation of driving a car equipped with in-vehicle information and communication systems (IVIS).

These in board systems should be adequately designed, not only in terms of their interfaces, but also in such a way they could allow for easy, comfortable and safe interactions with the driver. This means that the systems should be very co-operative with the driver, avoiding any conflict with his or her limited resources to perform the driving task safely.

This research aims to give inputs for the design and safe use of IVIS, particularly concerning older driver's needs, as they have particular characteristics and behaviours and represent a significant increasing percentage of licensed drivers.

#### **4.9.3 State of the Art**

Recent technological advances have led to the development and introduction of different information and communication systems into the vehicles. One of the goals of such systems, as outlined by ITS America (Dennis et al, 1999), is to present information to the driver so that it is quickly understood and not distracting. Human factors and ergonomics research is being performed on this issue aiming at ensuring road safety. One current effort is to create guidelines for the development and implementation of such systems with

the goal of creating safe, efficient and effective interactions between the driver and the system.

Designers intend that these systems should improve safety, although it is possible that the variety and number of these vehicular enhancements might reduce safety by increasing the driver mental workload. According to Kantowitz and Simsek (2001), excessive information inside the vehicle and odd road geometry contribute to a higher driver mental workload, which is referred by numerous authors to be related to high accident risk. Thus, it is important to assess driver mental workload, particularly when interacting with such systems.

The increase of mental workload imposed by driving with IVIS is due to the fact that the corresponding human-machine interaction represents an additional task, requiring drivers to switch their attention between the system and the driving task. This fact has the potential to disrupt the overall performance, particularly in people who can't switch rapidly their focus of attention. A study conducted by Noy (1989) has shown that driving was influenced by the performance of a secondary test. According to Moss and Triggs (Noy, 1997), driving performance vary inversely with switching time. Moreover, Kanhehan et al. (in Noy, 1997) found a significant correlation between attention switching time and accident rate.

Although the relation between switching time and age, outside of the driving domain, is unclear, it is the task nature and complexity that may dictate this relation (Moss and Triggs, in Noy, 1997). According to Graham and Mitchell (in Noy, 1997), older people have difficulties in situations requiring divided attention or simultaneous performance of two or more tasks. The ability to select relevant information from the environment in useful time is also reduced with ageing. Although there are no significant differences between young and older drivers when performing a single driving task, Warnes et al (1993) found that, when dual or multiple tasks are presented to drivers, the decreased abilities of older people become significant.

Ageing is a highly complex, dynamic and slow process, involving many internal and external influences, including genetic programming and physical and social environments (World Health Organization, 1998). In a healthy ageing process, age-related decreases don't have direct effects on task performance due to some strategies that older people develop to compensate their declines. However, conditions for using their previous experience should be provided, which means that older people require a more stable and user-friendly road environment. This is not the case once the nowadays road system is much more complex than three or four decades ago, when drivers who are over 65 years old got their driving licenses. Although some in board information systems could represent a great help for older drivers in terms of providing additional compensatory strategies, a generational effect could lead them to avoid the use of these systems, as they are not familiarised with new technologies. Aiming at an increase in road safety, characteristics of older drivers should be taken into account on the design of in-vehicle information systems.

#### **4.9.4 Objectives and Expected Results**

This project will be centred on the study of the impact of multiple visual and auditory inputs from in-vehicle information systems (IVIS) on the driver behaviour, aiming:

To assess the driver mental workload while interacting with IVIS in different categories of roadway configuration and traffic density;  
To identify the categories of traffic situations that represent higher risk for driving together with the performance of an additional task;  
To define priorities for the interaction with IVIS, in function of the information relevance for the driving task.  
To identify the changes on the driving task produced by the interaction with IVIS that should be considered for training and licensing procedures.

In addition, the project aims to identify age-related differences in the driving task performance based on the driver cognitive resources for information processing and decision-making in function of the traffic situation.

The expected results could be expressed in terms of useful recommendations for road safety improvement that should be provided to the automotive industry and transport authorities, as well as identified needs for further research. In addition, the results of this research will be compared to others issued from similar research projects on a basis of the expected knowledge sharing of HUMANIST.

Considering that a sample of older drivers will be included in the experiments, the identification of their specific needs concerning the use of IVIS will give inputs to the HUMANIST Task Forces A and F.

#### **4.9.5 Scientific Approach**

Being the project centred on the study of the impact of multiple visual and auditory inputs from IVIS on the driver behaviour, the experimental protocol will include tests on a driving simulator and on an instrumented car. In the frame of a National research project that has been submitted to the Ministry of Science, the University of Porto (FEUP), which is a partner in this project, will provide these experimental means.

The definition of scenarios for the driving simulator and the road environment for field tests will follow the categories of road configurations and traffic densities that will be previously defined. The variables to be analysed will allow at assessing the driver workload while performing an additional task represented by the interaction with in board information and communication systems. Therefore, visual strategies, driving performance (keeping lane, speed, incidents, errors and omissions), as well the additional task performance will be registered. In addition, heart rate will be continuously registered during the tests performance.

These tests will be performed by a sample of drivers selected on the basis of defined criteria of driving experience and the performance of specific laboratory tests to define their characteristics. The sample will be composed of two sub-groups according to two categories of age: up to 40 years old and 60 and over, aiming at identifying age differences and the corresponding specific needs.

#### **4.9.6 Experimental Means**

The experiments included in this research project will be carried out in the city of Porto, under a co-operation between the two universities: UTL and Porto (FEUP). Therefore, the

laboratory tests for the sample selection will be performed at the Traffic Analysis Laboratory of FEUP.

A driving simulator equipped with systems for collecting data (visual strategies, keeping lane and physiological parameters) and IVIS interfaces (a simulated navigation system and a mobile phone) according to the driving scenario is being developed by FEUP. This work will follow the identified roadway categories and traffic densities and their classification in terms of complexity.

An experimental car equipped with IVIS interfaces (a navigation system and a mobile phone, at least) and the same systems for data collection is being developed by FEUP in order to allow for tests in real driving situation.

#### **4.9.7 Supervision**

The PhD thesis will be performed in co-operation with the University of Porto (FEUP), which will provide the experimental means for the experiments in Portugal, and INRETS (LESCOT), which will host the student for the participation in an experiment.

#### **4.9.8 Co-supervisors**

Anabela Simões, Associate Professor at the Ergonomics Department of the Technical University of Lisbon.

To be defined at the Laboratory of Ergonomics and Cognitive Science Applied to Transport from INRETS.

#### **4.9.9 References**

- Dennis J. Collins, Wayne J. Biever, Thomas A. Dingus, Vicki L. Neale (1999). Development of Human Factors Guidelines for Advanced Traveler Information Systems (ATIS) and Commercial Vehicle Operations (CVO): An Examination of Driver Performance Under Reduced Visibility Conditions When Using an In-Vehicle Signing and Information System (ISIS), Publication N. FHWA-RD-99-130, Washington D.C.
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## 5. RESULTS

### 5.1 CURRENT PROGRAMME.

The main steps of the process for the first Joint Programme of Activities are the following, as defined on the “Report on the mobility requirements, rules and organisation” (deliverable 1.1 of the NoE):

- The process was launch by July.
- Partners sent their PhD proposal to the Steering Committee (SC).
- The SC gave its approval.
- Partners published their PhD positions, nine has already been publish on Humanist Web and other webs.
- End of September - October the Candidates should have been chosen.
- The Grant goes from autumn 2004 till the end of 2007 (36 months).

Therefore, before the end of this year, nine partners that finally will be hosting a PhD Grant, with all the implications and obligations with the Network that are explained in the “Report on the mobility requirements, rules and organisation” (deliverable 1.1 of the NoE).

Partners that will host a PhD Grant:

	PhD Position
ERT	
INRETS	X
Bast	
FACTUM	X
CDV	X
CUT	X
DTF	
Eurisco	X
CERTH/HIT	
BIVV	
ICCS	
EC – JRC	
NTUA	
SWOV	
TNO	
TOI	
TRL	X
UPM	X
UTL/FMH	X
VTI	
VTT	
IFADO	X
Total	9

## **5.2 NEXT STEPS.**

In the coming Joint Programmes of Activities the rest of the activities of Task Force 1 will be launched, if agreed by the partners. These activities would be:

- Post Doc Grants
- Visits Between Partners
- Reception of Students

On the other hand, PhD Grants will be closely followed by the Network during the whole duration of the researches.

### **5.2.1 *PhD Positions***

The next Milestones for the monitoring of these Grants are:

- + 1M PhD Candidates selected
- + 12 M first progress report and clear definition of the work.
- + 24 M second progress report.
- + 36 M third progress report.
- Participation on Humanist activities:
  - Workshops

### **5.2.2 *Post Doc Positions***

It was previously agreed that this activity would be included in the next JPA. If so the process might start in spring – summer 2005. The main steps are already defined in the “Report on the mobility requirements, rules and organisation” (deliverable 1.1 of the NoE), and are similar as the ones employed for the PhD Positions.

### **5.2.3 *Visits Between Partners and Students Reception.***

It was previously agreed that this activity would be included in the next JPA. If so the process might start in spring – summer 2005. The main steps are already defined in the “Report on the mobility requirements, rules and organisation” (deliverable 1.1 of the NoE).

## **6. CONCLUSIONS**

This first annual research exchange programme of the Humanist NoE has been launched with success and a wide participation of partners and candidates.

In the next months nine institutions will be hosting one PhD each, which will contribute to the development of the Network in great extend.

## **7. REFERENCES**

[1] Humanist NoE: “Report on the mobility requirements, rules and organisation”  
(deliverable 1.1 of the NoE)

[2] Humanist NoE: Annex I - “Description of Work”