Editorial: Knowledge Needs on the Implementation of Automated Driver Assistance Systems

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Recently, considerable technological progress has been made in the field of Automated Driver Assistance Systems (ADAS). Electronic devices inform or support the driver in accident-prone driving situations, in order to improve the critical task of driving a motor vehicle. Potentially, ADAS offers important advantages for road transportation: increased control with respect to the speed and the position of vehicles on the road is important for establishing homogeneous traffic flows and reducing the number of accidents. As such ADAS is assumed to have a positive impact on the use of road infrastructure and traffic safety (Boussuge & Valade, 1994). Moreover, this could lead to a reduction of energy use and polluting gas emissions (Barth, 1995; Michaelian & Browand, 2000). As soon as parts of or the whole driving task are supported and/or executed automatically by ADAS, vehicle driving could become more comfortable and more convenient as compared to today's manual driving (Stevens, 1997; Hoedemaeker, 1999). These expectations imply a high potential in individual and societal advantages. In various countries, therefore, transport policy makers are increasingly interested in the automation of vehicle driving tasks. However, current policy development regarding ADAS is highly complicated by, among others, much uncertainty on future ADAS development and implementation in terms of whether ADAS implementation will contribute to or conflict with transport policy goals, and the basic societal conditions required for ADAS implementation (Marchau, 2000).

Until now, the development of ADAS has been strongly technology driven and the performance and impacts of most ADAS prototypes has only been assessed in experiments under strictly controlled conditions, implying limited ecological validity (Marchau & Van der Heijden, 1998). Research is strongly focused on the technical potential of ADAS and specific aspects of ADAS implementation. Society oriented questions to be answered and choices to be made are still hardly considered. This could hinder ADAS developments in an early stage or lead to the implementation of ADAS systems that serve producers' and individual consumers' interests only, and not general transport policies. In terms of research, this implies that the efforts on ADAS technology development should be balanced with respect to research on the non-technological dimensions of ADAS implementation (Van der Heijden & Wiethof, 1999).

The theme of this special issue of the European Journal of Transport and Infrastructure Research is "Implementation issues on Advanced Driver Assistance Systems". Most of the papers result from recent research performed in European projects such as ADVISORS (**A**ction for advanced **D**river assistance and **V**ehicle control systems **I**mplementation, **S**tandardisation, **O**ptimum use of the **R**oad network and **S**afety), a project within the 5th Research Framework Programme of the European Commission. The ADVISORS project intends to develop and apply methodologies to assess the societal impacts and conditions regarding ADAS implementation. The objective is that the project results in the development of implementation scenarios in order to help introducing appropriate ADAS within the context of public policy making (Wiethoff et al., 2001).

The special issue contains six papers. The first four articles focus on the possible impacts of ADAS implementation; the latter two articles focus on societal conditions for ADAS implementation. In the first article, Carsten and Nilsson review issues in and procedures for the safety evaluation of ADAS. Currently, a standard procedure for approving these systems before they are taken into production, or even enter the market, is lacking. Therefore, systems might become available on the market which induce dangerous behaviour, or alternatively, the introduction of some 'safe' ADAS might be postponed or even cancelled.

There is an urgent need for a generic safety assessment procedures for ADAS. Carsten and Nilsson argue that a complete generic safety assessment approach for all ADAS is not feasible. Only for pure information systems, such a generic approach seems possible, not for intervening systems. The latter requires a structured process oriented approach in which experience and knowledge on safety outcomes of ADAS are built up in time. The approach starts with a full functional system safety evaluation, followed by a controlled, short-term and accompanied experiment in which potential dangerous driving scenarios are investigated. Finally, an unaccompanied long-term experiment is proposed, i.e. a field trial in which the system is used for longer periods, in order to investigate long-term safety impacts.

The need for such a process approach is underlined in the second article, by Brookhuis, De Waard and Janssen. They state that it is, currently, very difficult if not even impossible to forecast the level of reduction in accident fatalities and injuries due to ADAS implementation. This is in essence related to the low predictability of the impacts of ADAS implementation on driving behaviour. Since the task of driving an ordinary motor vehicle is changing in nature, in the direction of supervising a (partly) automated moving vehicle, new driving behavioural mechanisms are induced which could counteract previous driving performance. Among others, driving failures due to system complexity, increased reaction times, workload increases, and potential loss of driving skills are hypothesised. As such, there is a need to collect data and gain experience with these driving behaviour impacts, by means of long-term and large-scale real world pilots.

In the third and fourth article, the impacts of selected ADAS applications on traffic flow efficiency are studied on a microscopic respectively a macroscopic level. The selected ADAS applications involve systems which support the drivers in keeping a proper distance to vehicles in front (Adaptive Cruise Control or ACC), and systems that support the drivers in adjusting their speed to the maximum posted speed (Intelligent Speed Adaptation or ISA). ACC and ISA applications have promising characteristics with respect to impacts on roadway capacity, reliability, safety, and comfort. Moreover, the prospects of large-scale implementation of these systems, derived from a technology assessment and the views of experts in the field (for an overview, see Marchau, 2000) justify the focus of these two papers.

In the third article, Hoogendoorn and Minderhoud investigate the impacts of ACC and ISA for bottlenecks in motorways, such as lane-drops and on-ramp situations, by means of micro-simulations. Most of the studies in this field focus on homogeneous roadway stretches, implying that little can be concluded concerning impacts on bottleneck capacity. The analysis reveals that only the deployment of ACC improves bottleneck capacity. ISA has no considerable effect on capacity. Furthermore, both for ACC and ISA the impact on traffic safety could generally not be established.

The results of this microscopic simulation have been fed into a macroscopic network efficiency model in order to simulate network-wide traffic conditions. The traffic simulation and assignment model was applied to the Athens' traffic network. Golias, Yannis, and Antoniou present the results of this study in the fourth article. It was observed that the ADAS' impact increases proportionally with the market penetration of these systems. However, as traffic flow level increases, the average speed increase becomes smaller. Furthermore, it appears that ACC offers better network efficiency results than ISA. The benefits of a combined ACC and ISA system are only marginally better than the ACC alone.

The last two papers focus on two major conditions for ADAS implementation: sufficient acceptance among ADAS users and appropriate legalisation for ADAS deployment. In the fifth article, Marchau, Wiethoff, Penttinen and Molin discuss the acceptance of the most important stakeholders for ADAS deployment, i.e. the users of ADAS. In particular, the preferences of potential car- and truck-drivers are explored regarding vehicle-driving automation devices, applying conjoint analysis. This approach enables the analysis of the relationship between varying system operating characteristics and overall preference behaviour. It is often assumed that user acceptance of driver support systems is totally lacking, but this study points out that there is a sound basis for the implementation of these systems at a larger scale than is often thought.

In the final article, by Van der Heijden and Van Wees, the issue whether or not present legislation frameworks are able to accommodate a smooth development and market implementation of ADAS is handled. It appears that the present judicial frameworks in both the fields of vehicle safety standards and liability provide for (some) flexibility towards technical developments regarding ADAS in the sense that these frameworks do not contain many 'hard rules' prohibiting the introduction of these systems. This, of course, does not imply that there is no apparent need for ADAS safety standards. It is argued in this paper that from a product safety policy perspective the speed of technological developments as well as the innovative and specific nature of ADAS technology generate various tensions in the field or safety regulation. These tensions may (need to) have consequences for the weight that is put on public and private intervention mechanisms and the relationship between preventive safety standards and more reactive regimes such as product liability and post-market controls.

In conclusion, it seems that the knowledge augmentation on the other-than-technical dimensions of the implementation of ADAS is quickly gaining but still needs further attention. The papers in this special issue provide important information in this context, supporting how decision-makers might proceed with the implementation of ADAS so that it can reach its potential in attaining their transport policy goals.

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Guest editors

References

Barth M.J. (1995) AHS reduction of vehicle emissions : a preliminary study. In: *Proceedings of the annual meeting of ITS America 5th*, vol. 2, ITS America, Washington DC, p. 1137-1145.

Boussuge J. & J. Valade (1994) Projected impacts of driving-aid systems. In: *Proceedings of the First World Congress on Applications of Transport Telematics and Intelligent Vehicle Highway Systems*, Artech House, Boston, p. 1892-1900.

Heijden R.E.C.M. van der & M. Wiethoff (eds.) (1999) *Automation of car driving: exploring societal impacts and conditions*. TRAIL Research School, Delft.

Hoedemaeker M. (1999) *Driving with Intelligent Vehicles - driving behaviour with Adaptive Cruise Control and the acceptance by individual drivers*. TRAIL Thesis Series T99/6, The Netherlands TRAIL Research School, Delft University Press, Delft.

Marchau V.A.W.J. & R.E.C.M. van der Heijden (1998) Policy aspects of driver support systems implementation: results of an international Delphi study. In: *Transport Policy*, vol. 5, no 4, Elsevier Science Ltd, p. 249-258.

Marchau V.A.W.J. (2000) *Technology Assessment of Automated Vehicle Guidance: Prospects for automated driving implementation*. TRAIL PhD Thesis Series T2000/1, Delft University Press, Delft.

Michaelian M. & F. Browand (2000) *Field experiments demonstrate fuel savings for close-following*, PATH research report, UCB-ITS-PRR-2000-14, Institute of Transportation Studies, University of California, Berkeley CA.

Stevens W.B. (1997) Evolution to an Automated Highway System. In: P.A. Ioannou (ed.) *Automated Highway Systems*, Plenum Press, New York, p. 109-124.

Wiethoff M., M. Penttinen, T. Heijer & L. Bruinsma (2001) ADAS application opportunities and barriers: demand pull and technology push. In: *Proceedings of the 8th ITS conference - ITS Transforming the Future*, ITS Australia, Melbourne.