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FERSI position paper: Safety through automation? Ensuring that automated and connected driving contribute to a safer transportation system

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Abstract

In 2018, the Forum of European Road Safety Research Institutes (FERSI) published a report on automated driving (AD) from a road safety point of view, prepared by a dedicated FERSI Working Group with experts from eleven European countries. The group identified 23 high priority concerns or questions, clustered into four categories, to ensure that connected AD and co-operative ITS successfully contribute to a smart, green, and integrated transport system which at the same time is a *safe* transport system. The discussions resulted in ten principles to be fulfilled in order to optimise the safety effects of AD. Even if these principles may seem straightforward, the underlying questions are complex, and the identification and realisation of cost-efficient and effective solutions will require considerable effort. Many strong industrial and political driving forces exist, but so far improving road safety seems to get insufficient priority. FERSI therefore recommends a number of focused actions.

Keywords: Automated driving; Connectivity; Road safety; Policy making; Research.

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1. Introduction

Automated driving (AD) is an area where technical development has been remarkable under the past several years, and where the expected business potential is huge. Estimated projections suggest a tenfold increase in the market from approximately 54 billion USD in 2019 to around 560 billion USD in 2026 (Allied Market Research, 2019). The vehicle industry is competing with actors from the IT industry, and freshly spawned mobility actors in the area of Mobility as a Service (MaaS), to develop automated driving, often based on connected, automated vehicles (CAVs), not seldom in connection with co-operative intelligent transport services (C-ITS).

The market and technology drive in the area is considerable, and progress especially in certain AI techniques has led many to equate automated driving with removing the human from the loop in driving, suggesting that this could reduce the many traffic accidents which are today attributed to "human error". However, many research organisations, international and national traffic safety institutes and road administrations have raised concerns about the traffic safety aspects of automated driving, and indeed in the past year, fatal crashes have been reported in connection with automated vehicles under test and trial conditions (Banks, Plant, & Stanton, 2018), as well as in connection with production-level vehicles, featuring high levels of automation (Poland, McKay, Bruce, & Becic, 2018). At the European level, many R&D projects are ongoing in the area of automated driving and ITS, conveniently compiled at https://connectedautomateddriving.eu/. A recent report from The European Road Transport Research Advisory Council (ERTRAC) identifies ten major challenges that need to be solved for connected and automated driving (CAD) to become a reality (ERTRAC Working Group "Connectivity and Automated Driving", 2019). Many individual research groups, as well as umbrella organisations such as the Forum of European National Highway Research Laboratories (FEHRL), the European Transport Safety Council (ETSC), and the European Conference of Transport Research Institutes (ECTRI) have pointed to the need for addressing the traffic safety aspects of automated driving and C-ITS. It was concluded within the Forum of European Road Safety Research Institutes (FERSI) that there was a need to compile the many concerns raised by the forum's traffic safety experts in such a way that they could lead to identification of areas where policy making and additional research would be necessary to achieve maintained or improved road traffic safety. The present contribution describes how a dedicated working group (WG) of FERSI experts took on this compilation task, which questions were identified, and what the resulting recommendations were.

2. Aim

The working group had three aims, namely to:

- identify critical issues and questions begging an answer regarding traffic safety in light of the rapid development of CAVs and C-ITS
- group these questions in functional categories
- suggest actions that policy makers, the industry or the research community must take in order to enable road traffic safety to be maintained or raised as CAVs and C-ITS is proliferated in the near future.

3. Method

The working group consisted of some 20 experts on traffic safety and automation representing different FERSI's member organisations. Four workshops took place during 2017. The task at these workshops was to make an inventory of issues and traffic safety concerns or questions in need of solving, and to cluster these into main categories. In addition, a targeted literature study was carried out to shed more light on the individual questions identified. For each question, a suggested action was identified. Finally, based on the action list, a smaller number of more general principles were formulated.

4. Results

4.1. Traffic-safety concerns

The experts in the FERSI WG identified 23 different traffic-safety-related concerns or questions, begging to be answered (FERSI, 2018). These were grouped into the following four main categories:

I. How can automated and connected driving and ITS *improve* road safety? What conditions should be met,

and which actions taken? More specifically this category concerns questions like how to ensure that AD and ITS development incorporates relevant and appropriate safety and human factor considerations? How to adapt and develop in-vehicle technology as well as urban and non-urban infrastructure, so that AD and ITS enhancements lead to substantially increased safety levels? How to integrate and harmonise information from other services with AD functions?

II. Which road safety issues will likely *not* be solved by AD, connectivity and ITS? In particular, are there groups of road users which *could* benefit from AD and ITS, but are unlikely to do so unless special action is taken? Most AD and ITS developments focus on car and truck drivers and passengers as well as on slow-moving public transport "pods". The main concern here is that in particular vulnerable road users might not or only in a limited way benefit from these developments, whereas they are a very important group when trying to reach the European road safety goals.

III. What road safety issues may be *caused* by AD, connectivity and ITS? What actions can be taken to avoid this? This broad category of questions relates to issues like maintaining attention, hand-over situations, mode confusion, training needs, as well as the situation during the expected lengthy transition phase towards full automation during which automated vehicles, partly automated vehicles and non-automated vehicles and road users have to interact.

IV. How should *testing, certification and validation* methods be adapted and how should "best performing" AD/connected systems and ITS *best practices* be identified? AD systems consist of the vehicle itself as well as a wide variety of sensors, connected information sources, and algorithms designed to detect, understand, and decide based on all of the information at hand. This will make issues related to testing, certification and validation considerably more complicated. Next to the technical systems there are the human users, and increasing automation will require additional skills and capabilities and related conditions for training and licensing.

4.2. Some additional concerns

The issues mentioned above directly relate to road safety and are of primary concern to FERSI, given its mission and objectives. Nevertheless, the WG identified several other relevant issues and prerequisites in order to realise public acceptance of AD and ITS and guarantee public safety and integrity. These issues relate to privacy issues caused by data sharing and proliferation, the effect of potential fraud and hacker attacks, the potential use of AD and ITS as tools for acts of terrorism, and the cost-efficiency of automated driving systems.

4.3. FERSI code of principles for "Safety through automation"

The WG suggested different actions for the safety concerns listed. From these actions, a set of ten principles were formulated, intended to guide decision-making, research funding and, possibly legislation in the area:

1. Human Factors at the core

   "Human-Centred Design" shall be put the core of development to prevent new risks of new levels of automation and to render unbiased acceptance by users.

2. All potential user profiles

   Drivers of all types, backgrounds and ages should be catered for by systems designed in such a way that all drivers experience automation as safe and comfortable.

3. Safety in mixed traffic

   Given the expected increases of traffic situations where users of non-automated as well as of automated vehicles of various levels will share road space, it is necessary to adapt infrastructure, vehicles and driving education, to reduce safety risks caused by mixed traffic.

4. Safe communication between automated vehicles and providers of services

   Effective, secured, and error-free communication channels between automated vehicles and providers of services (vehicle manufacturers, mobility services, fleet operators, road administrations, infrastructure operators, etc.) must be established and maintained to ensure safe interaction between all types of road users and the connected road environment.

5. Safe communication between all road users

> Safe and secured communication among drivers of partially as well as fully automated vehicles, as well as with other road users – especially vulnerable and unprotected groups – needs to be in place.

6. Safety and automation benefits for vulnerable road users

> It must be ensured that vulnerable road users (VRUs) – pedestrians, cyclists, and riders of powered two-wheelers (PTWs) – also benefit from automation and that, where feasible, specific connectivity- or detection-based solutions are developed to increase the safety of these groups.

7. New training & testing

> All drivers of automated vehicles are to be well trained, tested, and licensed, in order to cope with driving in modes with different levels of automation, and, when required, be capable of resuming manual control. Automated vehicles should be able to establish whether the driver is fit to drive and to stay in control.

8. New tests & tools

> Test procedures and tools (both virtual and physical) are to be set in place that cover the comprehensive set of scenarios needed to evaluate, validate, and certify automated systems – and updates and technical inspections are to be integral part of that process.

9. Policy mechanisms for incorporating safety considerations

> Policy mechanisms are to be set in place to ensure that automated and connected driving development takes safety and human factor considerations into account – and brings about substantial safety benefits in a timely manner for all road users.

10. Impact assessment

> Evaluation methods and models are to be established to measure the impact of automation – and information from crash investigation as well as data from automated vehicles and their use both in tests and operation, should be made openly available to impartial research for the sake of further improving safety.

5. Conclusions and discussion

Automated Driving (AD), along with connected driving and Intelligent Transport Systems (ITS) are likely to transform the European scene as regards transportation of both people and goods. Many strong industrial and political driving forces exist, ensuring that road safety gets insufficient priority in relation to current development requires dedicated attention and focus. FERSI therefore recommends that, at the European level, action is taken to ensure

- the prioritization of research funding addressing the 23 questions listed here,
- the development of policies that take research findings into account,
- the establishment of a scheme for evaluating industry's innovations by the research community to establish and proliferate best practices/best system knowledge among member states, and
- the promotion of involvement of other stakeholders, e.g. insurance companies, road administrations and owners, municipalities/cities, representatives for law enforcement, the research community as well as organisations representing different groups of (for instance) vulnerable road users. This is a much-needed complement in addition to the vehicle and supplier industries which are currently the main actors, ensuring development and policy making.

Regarding the four main categories of questions, for category I issues, the conclusion is that several measures must be taken to ensure that connected automated vehicles (CAVs) and co-operative intelligent transport services (C-ITS) do indeed contribute to improved traffic safety and that more research is needed. As regards category II issues, it might be that some groups in society (both demographically and with respect to transport modes) will not benefit from the introduction of CAVs and C-ITS. Furthermore, there is a risk that funding for "traditional" traffic safety falls behind, as an increasing share of funding goes towards automation and ITS. When it comes to the category III, the issue of automation technology actually contributing to causing accidents, a whole range of

actions should be taken. The challenge regarding mixed traffic must be solved, automation mode awareness must be increased, technology has to be developed to protect vulnerable road users, and actions should be taken to increase acceptance as well as to introduce new types of driver training and possibly also certification. Category IV is slightly different from the other three, in that it is more of a consequence of a new division of responsibility between vehicle vendor, infrastructure provider, and supplier of connected systems for mobility services. This disruptive change in the eco-system is likely to demand a change in roles, not without resemblance with the organization of the flight industry, which may be worth noticing.

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References

Allied Market Research. (2019). *Autonomous Vehicle Market by Level of Automation (Level 3, Level 4, and Level 5) and Component (Hardware, Software, and Service) and Application (Civil, Robo Taxi, Self-driving Bus, Ride Share, Self-driving Truck, and Ride Hail) - Global Opportunity Analy.* Portland, Oregon: Allied Market Research. Retrieved from https://www.alliedmarketresearch.com/autonomous-vehicle-market

Banks, V. A., Plant, K. L., & Stanton, N. A. (2018). Driver error or designer error: Using the Perceptual Cycle Model to explore the circumstances surrounding the fatal Tesla crash on 7th May 2016. *Traffic Injury Prevention, 108*, 278-285. doi:10.1016/j.ssci.2017.12.023

ERTRAC Working Group "Connectivity and Automated Driving". (2019). *Connected Automated Driving Roadmap.* ERTRAC. Retrieved from https://www.ertrac.org/uploads/documentsearch/id57/ERTRAC-CAD-Roadmap-2019.pdf

FERSI. (2018). *Safety through automation.* FERSI, Forum of European Road Safety Research Institutes. Retrieved from www.fersi.org

Poland, K., McKay, M. P., Bruce, D., & Becic, E. (2018). Fatal crash between a car operating with automated control systems and a tractor-semitrailer truck. *Traffic Injury Prevention, 19*, 153-156. doi:10.1080/15389588.2018.1532211