Informal document No. 2

Distr.: General
12 March 2015

Original: English

Economic Commission for Europe

Inland Transport Committee

Working Party on Road Traffic Safety

Seventieth session
Geneva, 23-26 March 2015
Item 4 (c) of the provisional agenda

Autonomous Driving

Submitted by the Governments of Belgium and Sweden

Informal Document No. 2, submitted by the Governments of Belgium and Sweden, describes and analyzes the role of the driver in a vehicle with a more advanced level of automation.

I. Background

1. Advanced driver assistance systems (ADAS) have been in development for many years and several of them are commercially available today (e.g., adaptive cruise control, forward collision warning). Typically, these systems are designed to support vehicle drivers in safety-critical situations by providing information and warnings to them, or by automating the longitudinal control of the vehicle (i.e., speed and distance). The driver is still involved in the driving task and must be aware of the vehicle status and road traffic situation (usually called driver-in-the loop). Recent evaluations of ADAS in the real-world traffic show that these systems are beneficial as they have the potential to reduce the number of crashes as well as to improve fuel and time efficiency.

2. Introducing even more automation in vehicles is envisioned to enlarge these benefits and thereby address several major societal challenges. Consequently, several stakeholders are ready to take the step beyond automated longitudinal control to introduce some level of lateral control. The purpose is to disengage the driver from the driving task in order to let him/her engage in other activities. While some of the stakeholders aim to develop automated control under specific conditions (partial automation), others are working towards completely self-driving vehicles. A common denominator however, is that the driver will not actively be monitoring the vehicle status and traffic situation, making decisions and hence providing input to the driving task at all times (usually called driver-out-of-the-loop).

3. These different approaches to automation witness the many challenges that the automotive industry and society faces. It may be easy to believe that the challenge is primarily technical in nature, such as ensuring the reliability of these systems. However, today's road traffic system is very complex, with interaction among its various elements which is often difficult to predict and control. For example, the technology has to be adapted to human criteria and restrictions and the infrastructure may need to be adapted to vehicle technology. According to research the most prominently matters are related to human factors issues of safety, usability and acceptance, as well as institutional and legal issues. These are problems that are many times more difficult to overcome and must be overcome, largely in parallel with the traditionally ”hard” technological issues.

II. Challenges for UNECE

4. The traditional way of steering and regulating the road transport system has involved regulating performance and permitted variations in the same among the individual components in the system (road user, vehicle, road) in isolation. Such an approach does not take into consideration the complex interactions between the components which, according to systems theory, is necessary to increase the safety of a system.

A. Regulating human factors issues

5. An important challenge is the human factors perspective on the technology. For a long time there will still be an interaction between the driver and the vehicle. Consequently different human factor challenges need to be taken into consideration, some of them described below. These must be considered and maybe regulated, at least on a functional or system level.

B. Regulating obligations of the driver and the vehicle

6. The convention on road traffic regulates the obligations (not the responsibility) of the driver through traffic rules regarding how to behave in different traffic situations. By doing so, the intention is that drivers will act according to the rules and hence road traffic will be safe. However, we know that drivers or road users never follow all these rules for different reasons. Consequently we are at the moment using technology in order to support the driver to follow the rules or to be ” in control” (DAS or ADAS).

7. But technical development is now taking further steps leading to technology taking over the role of the driver gradually. As a consequence there is a need to further analyse how the obligations should be distributed among the driver and the vehicle. Which obligations should the vehicle have when the vehicle is in control and which obligations should the driver have? Ultimately one can maybe state that the vehicle should have the same obligations as the driver when the vehicle is in control.

C. Regulating structure

8. It is important to discuss where and how the issues described above should be regulated. It is obvious that the technology and the road user cannot be regulated in isolation from each other. However, the structure of UNECE WP:s today is very much supporting such an isolated approach with WP.29 dealing mostly with vehicle technology and WP.1 with the driver/road user. Of course some issues may still be solely the responsibility of a single WP but increasingly WP.1 has to take technology into consideration much more in its work since it is not possible to isolate the driver from technology. Otherwise we will be left behind. The other way around there is a need for WP.29 to take human factors issues into consideration in their work. WP.29 is not any longer dealing only with discrete technical components which properties can be regulated in isolation. The components are often parts of a complex system which includes the human being. The knowledge of human behaviour in relation to complex technology (Human Factors) will be of utmost importance in the future. For clarification it should be noted that WP.29 deals with some HMI-issues (Human Machine Interface) which could be said constitutes only a limited part of the Human Factor-issue.

9. For that reason it is not only important but necessary to investigate different possibilities to increase the co-operation between WP.29 and WP.1.

10. It should further be discussed if it is wise to regulate too much at this point of time since the uncertainty of technological development is rather big. Maybe working with guidelines and similar tools may be more effective at the moment.

D. What can be done in the near future

11. Belgium has below made an analysis of the Vienna Convention in relation to the issues that have been raised in this informal document. This analysis should be discussed in WP.1 and be subject to concrete measures.

12. Further WP.1 should approach WP.29 in order to discuss concrete ways of cooperation.

13. We should also clarify how to cope with the amendment just adopted in WP1. The amendment means that certain DAS are allowed but there is still not clarified the ”correct” behaviour of the driver in relation to these systems. When should they e.g. be overriden and when should they be switched off? Is it up to the different member states to put in their

national traffic legislation which systems must be switched of or must be overridden, and how do countries know which DAS are built in which cars? It is important to try to avoid a patchwork of national legislations and regulations.

E. Human Factors challenges

14. Automation will shift the human’s driving tasks from manual control, being ”in-the-loop”, to being more or less ”out-of-the-loop” when handing over the control to the vehicle. This results in some challenging Human Factors issues which are described below. However, it is important to underline that these challenges must be continuously viewed in relation to technical development since technology in the future may overcome these issues, e.g. when we are talking about driverless vehicles.

F. Acceptance and comfort

15. Acceptance of vehicles with different levels of automation is of crucial importance. It will determine whether systems will actually be used. Acceptance can be divided into four categories:

- The utility and usefulness of the system from the driver’s point of view;
- The usability of and satisfaction with the system by the driver;
- The reliability of the system and trust (subjective) in the system by the driver;
- The trust in the system by other road users.

G. Situational awareness

16. The term situational awareness (SA) is often used in the field of Human Factors to describe how much an operator is aware of what is going on around him or her. In case of automated driving, situational awareness is often referred to as ”being aware, realising and understanding the modus of the vehicle”. That is, the driver or the monitor has to realise whether a system is on or off, what the system does and does not support and what the driver still needs to do. One very important issue in SA is the HMI (Human Machine Interface) that is used for providing information. This issue of SA also plays a role in understanding a driver support system. If a driver is not adequately aware of whether the system is on or off, and what it does and does not do, this may lead to safety issues.

H. Loss of skill

17. Automation may lead to loss of skill. If people are able to perform a task relatively well, but they do not perform this task for a long time, they lose the skill to perform that task. In case of fully automated vehicles, this may also be an issue. For instance, if someone gets his bus drivers license but he only operates an automated bus (simply being a monitor), he may lose his specific bus driving skills. With this respect, partially automated vehicles do not pose a particular issue since normally drivers still operate the vehicle manually. In case of large scale implementation of partially automated vehicles, it is also necessary to have a minimum requirement for a driver to manually operate the vehicle.

18. In case of fully automated systems, loss of skill will be high. In terms of Human Factors, this can be associated with severe risks if an operator only monitors the system without often practicing the task. Successful transfer of control upon system failure requires

a skilled driver who remembers how to take over from the system and continue the task as effectively as the automated system. However, this might not be the case if the system has a safe ”shut-down mode” meaning that the driver does not have to intervene if the system fails.

I. Behavioural adaptation and risk compensation

19. Behavioural adaptations are those behaviours which may occur following the introduction of changes to the road-vehicle-user system and which are not intended by the initiators of the change. It is a well-known fact that humans will find ways to maximize their personal benefits from the systems, and once we observe those adaptations we can generally understand them. But without observing them, we cannot predict them.

J. Workload

20. Automated systems can have profound effects on operator workload leading to “automation surprises”. The aim of automation technologies was originally to reduce errors and increase the economy of operations whilst attempting to reduce workload and potentially training requirements. However, there are many examples in the field of Human Factors where automation did not reduce workload but simply changed its composition. Whilst physical workload may decrease under workload, mental workload may, in fact, increase. This in turn can lead to different, unforeseen errors occurring. Automation can also offer, however, substantial benefits in human workload reduction, improved performance, and safety when properly designed and used.

21. Another effect of automation is that it can reduce an operator’s situation awareness. Undertaking a task manually may induce higher levels of workload but the benefit is a greater awareness of the task itself.

22. With partial automation a situation where workload becomes “lumpy” with peaks and troughs of activity can be envisaged. An automated system may be able to effectively support an operator in times of low workload, e.g. where other traffic is scant or the road layout straightforward. However, when workload is high, an automated system may impede or hinder the operator in his or her task. There is further complication when the automation is switched on and off, with the potential for operator confusion (due to decreased situation awareness) which in turn could lead to an unprecedented increase in workload in safety-critical scenarios.

K. Authority transition

23. Authority transition is defined as the timing and procedure of transferring responsibility from the human to automation system, and vice versa. Some situations requiring a transition are automation failure, road blockage, severe weather conditions, sudden manoeuvres by another vehicle, and operator preference. A proper automation system should avoid automation surprises, and facilitate proper trust on automation. The human should be aware of the automation system’s limits well in time and be able to take over the vehicle control when needed.

L. Responding to system failures

24. Although automating the driving task has a number of advantages, there are also some possible risks. Since many road accidents are caused as a direct result of driver-

related errors, there is a need to make sure that the lack of driver response to system failure actually does not make things worse. This may be the result of removing the human out of the driving loop, but still making the driver responsible for responding to system failure that occur only rarely.

M. Overreliance

25. Overreliance (or complacency) is defined as the situation where the human does not question the performance of automation and insufficiently counterchecks the automation status. Distraction and poor judgment are two major causes of accidents. Overreliance and loss of vigilance could make these problems worse.

N. Human-to-Vehicle instruction and Vehicle-to-Human feedback

26. Not only the presence of the feedback is important, but feedback should also be provided in a timely and useful manner. Humans may miss nonsalient warnings, whereas too salient warnings are annoying. Feedback provided too early or inappropriately (i.e., false alarms) can result in distraction, ignoring the alarm, or shutting down the alarm system entirely. Displays and automation settings may need to be configurable based on operator preference. Setting customization, however, can be a double-edged sword because of potential confusion by other users.

O. Fully autonomous driving versus the Vienna Convention

27. Article 1, (v), of the convention defines a driver as any person who drives a motor vehicle or other vehicle (including a cycle), or who guides cattle, singly or in herds, or flocks, or draught, pack or saddle animals on a road. The convention in essence lays down rules of conduct for drivers, this is proven by the fact that the word "driver" is used a 175 times and is mentioned in almost each article (except in art. 9, 20, 24, 26, 29, 36, 37, 38 and 40) and in all the annexes.

28. When driving assisting systems take over the full control over the vehicle, the DAS replaces at that time the driver. Consequently, those systems must take over all the driving tasks from the driver. Instead of amending almost each article of the convention, it seems wiser to only amend the definition of "driver":

29. Article 1, (v) "driver" means any person who drives **or a vehicle system which has the full control over the vehicle from departure until arrival and is in conformity with the conditions of construction, fitting and utilization according to international legal instruments concerning wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles[1],** driving a motor vehicle or other vehicle (including a cycle), or who guides cattle, singly or in herds, or flocks, or draught, pack or saddle animals

[1] The UN Regulations annexed to the "Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions" done at Geneva on 20 March 1958.
The UN Global Technical Regulations developed in the framework of the "Agreement concerning the Establishing of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles" done at Geneva on 25 June 1998.

on a road.";

30. Also a few editorial changes in other articles are necessary, e.g. the wording "his vehicle" should in each case be replaced by "the vehicle". For example, article 8.5 should than mention "Every driver shall at all times be able to control **the** vehicle or guide his animals.

31. The amendments already approved within WP1 allow"semi-autonomous" driving, meaning that the presence of a person as a driver, who can take over the control, is still necessary. With full automation systems who will take over all the driving tasks, the presence of a person as a driver, is no longer needed.

Adding an extra paragraph within article 8 of the convention

III. Amendment of Article 8:

32. A new paragraph (i.e., paragraph 5ter) is to be inserted into Article 8. The paragraph 5ter shall read as follows:

(a) 5bis. Vehicle systems which influence the way vehicles are driven shall be deemed to be in conformity with paragraph 5 of this Article and with paragraph 1 of Article 13, when they are in conformity with the conditions of construction, fitting and utilization according to international legal instruments concerning wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles*;

(b) Vehicle systems which influence the way vehicles are driven and are not in conformity with the aforementioned conditions of construction, fitting and utilization, shall be deemed to be in conformity with paragraph 5 of this Article and with paragraph 1 of Article 13, when such systems can be overridden or switched off by the driver;

(c) 5ter When vehicles are driven by a vehicle system as mentioned in article 1, (v), the paragraphs 3 & 4 of this Article do not apply.