HF-working stream: Proposed detailed HF-related requirements

The performance topics and detailed requirements described below aim to ensure a safe interaction between the user and the ADS. This is achieved by increasing the usability of the technology, simplicity in the perception of the user and an appropriate mental model of the ADS. The need for an appropriate mental model has been stated by, for example, Halasz and Moran (1983): ".... the psychological function of a mental model of a system is to provide an effective problem space [...] in which the user can reason about the operations available on the system." All the requirements below have been derived to achieve these safety-related considerations.
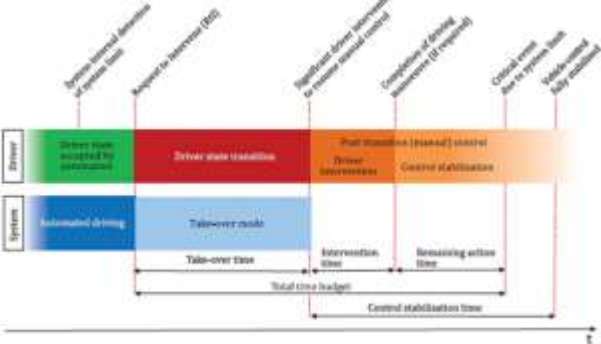
As is now indicated in the overall safety topic with user we mean at the moment: 'authorised user in the vehicle'. With this we hope to indicate that the PTs 9-15 relate to L3/L4 driving. This also means that L5 still needs to be addressed. As well as remote driving.

Halasz, F. G., & Moran, T. P. (1983). Mental models and problem solving in using a calculator. In Proceedings of CH1'83 Human Factors in Computing Systems. New York: ACM

	Performance Topic	Detailed Requirements	Comments
	The ADS should interact safely with the authorized user in the vehicle		Suggestion based on the comments of stakeholders that PT and DT below refer to 'L3 and L4' systems. Dedicated PT may be necessary for L5 and remote control.
9 old	Activation of an ADS feature should only be possible when the conditions of its ODD have been met		Included in new PT12

9 new	User interaction with and the interface of ADS (features) should have high-level commonality of design so as to support users' mental model of system operation ADS (features) should be designed according to Harmonized/Common HMI principles to support the mental model	1) The ADS (features) should use interfaces with high-level of commonality
		2) The operation design of the interaction should have be in common:
		    a) [use of common sequence of states in the transition/activation/overriding/...]
		3) The interaction should be simplified:
		    a) [Limit the number of roles]
		    b) [Limit the number of potential transitions]
		    c) [Limit the number of settings]
			Japan: Explain mental model
			
			Reply: Is done in the introduction
			
			High level commonality supports users' mental model of system operation.

		d) [Limit the number of different interaction modes]	
10 old	~~The user should be informed about the ADS status (when the ADS is activated) with regards to ODD~~		Included in PT10
10 new	The ADS should provide clear and unambiguous information to the user	1) The ADS should inform ~~present information to~~ the user on the current conditions: a) ADS status information b) User Role c) Potential roles to activate d) Responsibility e) Permitted NDRA f) "Standard" information i) Vehicle speed, range and Time to Fuel g) ADS failure information h) Availability of automated features 2) The ADS should inform ~~present information to~~ the user on the upcoming conditions: a) ODD boundaries b) Upcoming actions or change in roles c) Oncoming decisions/manoeuvers d) Estimated time until take over ~~to overtake~~ in normal conditions e) Warning for upcoming transition request f) Confirmation request for upcoming transition 3) The ADS should ensure safety related information is prioritised 4) ~~The ADS should present the information so as to assure a safe interaction:~~ ~~a) Timing requirements~~ ~~b) Priority requirements~~ ~~c) Saliency requirements~~	Open issues: Which information needs to be presented continuously? Which information needs to be presented where? What kind of information falls under 1a) ADS status information? What kind of information falls under 1h) Availability of automated features OICA/CLEPA indicated that 1f can be removed OICA/CLEPA: 2e & 2f to be merged into: Transition related communicated

11 old	~~The user should be permitted to take over control from the ADS, if the ADS is designed to request and enable intervention by a human driver~~		Included in new PT14
11 new	The ADS should prevent misuse and errors in operation	1) The ADS should be designed to prevent inadvertent activation or deactivation 2) The controls dedicated to the ADS should be clearly distinguishable from other controls 3) ~~The ADS should be designed to avoid activation of an ADS outside its ODD~~ 4) ~~The ADS should be designed to avoid illegal settings~~ 5) The ADS should provide feedback when the user attempts to enable not allowed functions	3) covered in FRAV 18-06 PT2 4) covered in FRAV 18-06 PT4
12 old	~~The ADS should safely manage transitions of control to the user~~		Included in new PT13 and PT14
12 new	The ADS should assure a safe ADS feature activation	1) The ADS should inform the user that preconditions for activation are met 2) The activation should follow a common sequence a) Common sequence to be a pass/fail criterion 3) The ADS should provide confirmation that the system is activated	Clarification to remarks by OICA / CLEPA and Canada on merging and differences between the PTs: Reply: There are relevant differences from a user perspective and therefore with respect to the requirements of the ADS between 12, 13, 14. Therefore we would like to keep them separated.
13 old	~~The ADS should safely respond to user input errors~~		Included in new PT11
13 new	The ADS should assure a safe Transition Of Control	1) The interaction should follow a common sequence in the transition of control (change of user roles) a) Common sequence to be a pass/fail criterion	Canada: Should automatic re-engagements of ADS be permitted? Reply: Automatic re-engagement strategies must be considered. Under certain conditions automatic re-engagement might be

<table>
<tr><td colspan="2"></td><td>

Figure 2 — System-initiated transition from automated to manual driving [1]

2) Transition of control should return to a common default user role (to prevent mode confusion and other risks)
   a) This should normally be fully engaged driving (conventional driver)
   b) Common default user to be a pass/fail criterion
3) The ADS should continuously verify whether the user is available for the transition of control and warn the user if not available when required
4) The ADS should verify that the driver is in stable control of the vehicle to complete the Transfer of Control to the user
5) During transition, the ADS should remain active until the transfer of control has been completed or the ADS reaches a minimal risk condition

</td><td>

preferable. Currently not addressed

The MRM needs to be specified elsewhere

</td></tr>
<tr><td>14 old</td><td>~~The ADS should provide feedback to the user on its operational status~~</td><td></td><td>Included in new PT10</td></tr>
<tr><td>14 new</td><td>The ADS should assure a safe user initiated take over</td><td>

1) Under safe conditions the user is allowed to initiate a take-over of the ADS
2) The deactivation should follow a common sequence
   a) Common sequence to be a pass/fail criterion
3) The ADS should prevent and warn a user for a user initiated take over that would likely ~~will~~ lead to an unsafe situation

</td><td>

USA: 3 should only apply in special circumstances.
Reply: True. A strategy needs to be considered based on different cases. If a first attempt prevention is enough or the ADS has a better overview of complex traffic

</td></tr>
</table>

---

[1] Reference: ISO/TR 21959-1:2020(E)

		4) The ADS should provide a clear feedback of the successful user initiated take over
		  a) The clear feedback should be a pass/fail criterion
		5) The user initiated take over should return to a common default user role (to prevent mode confusion and other risks)
		  a) This should normally be fully engaged driving (conventional driver)
		  b) Common default user role to be a pass/fail criterion
			situations and prevents the take-over. Or other solutions.

15 old	~~The ADS should warn the user of failures to fulfill user roles and responsibilities~~		Included in new PT10

15 new	The ADS manufacturer ~~OEM~~ should provide tools for the authorized user to learn about system functionality and operation.	*On the general mental model (common understanding):*
		1) ADS manufacturer ~~OEM~~ should describe the possible educational approach:
		  a) Theoretical and practical training
		  b) How it aligns with common HMI and interaction
		2) ADS manufacturer ~~OEM~~ should provide documented information on ADS (features) capabilities and limitations (the information should also refer to specific scenarios)
		3) ADS manufacturer ~~OEM~~ should provide documented information on roles and responsibility of Driver/user and ADS when ADS (feature) is on/off
		4) ADS manufacturer ~~OEM~~ should provide documented information on allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override)
		5) ADS manufacturer ~~OEM~~ should provide a list of NDRA allowed when an ADS feature is active
		
		On the applied mental model (understanding the ADS-specifics)
		6) The ADS supports the user in correct operation (coaching)
		7) The ADS gives prompt feedback on erroneous operation
			USA: Only apply to an authorized user (not e.g. a child).
			
			Reply: Done
			
			Question: How should allowed NDRA be indicated.
			
			Reply: No idea yet but will be relevant at a more detailed level
			
			OICA/CLEPA: This PT should be addressed somewhere else

new	Human Factors process requirements for safe and usable ADS HMI/ safety management systems (SMS) approach	1) Analyses of user needs and risk, setting safety and usability objectives, 2) Conducting evaluations, particularly real world testing on real users (i.e., not the engineers developing the products)	Proposed by Canada. To be discussed after the GRVA meeting in September 2021

		3) Human factors design and testing activities should be assigned to qualified personnel, with clearly defined roles and responsibilities, including process oversight and sign-off. 4) Device performance should be monitored in the field and this information should be used to set future design targets.	
16	ADS vehicles that may operate without a **[user-in-charge/in-vehicle driver]** should provide means for occupant communication with **[a remote operator/user-in-charge/human driver/remote assistance personnel]**		Has not yet been addressed.

	Old Performance Topic	Included in new Performance Topic	New Performance Topic
The ADS should interact safely with the user			
9	Activation of an ADS feature should only be possible when the conditions of its ODD have been met	12	12: The ADS should assure a safe ADS feature activation
10	The user should be informed about the ADS status (when the ADS is activated) with regards to ODD	10	10: The ADS should provide clear and unambiguous information to the user
11	The user should be permitted to take over control from the ADS, if the ADS is designed to request and enable intervention by a human driver	14	14: The ADS should assure a safe user initiated take over
12	The ADS should safely manage transitions of control to the user	13, 14	13: The ADS should assure a safe Transition Of Control 14: The ADS should assure a safe user initiated take over
13	The ADS should safely respond to user input errors	11	11: The ADS should prevent misuse and errors in operation
14	The ADS should provide feedback to the user on its operational status	10	10: The ADS should provide clear and unambiguous information to the user
15	The ADS should warn the user of failures to fulfill user roles and responsibilities	10	10: The ADS should provide clear and unambiguous information to the user
16 (Not covered here)	ADS vehicles that may operate without a **[user-in-charge/in-vehicle driver]** should provide means for occupant communication with **[a remote operator/user-in-charge/human driver/remote assistance personnel]**		