OICA/CLEPA Input

to the

Special interest group on UN-R 157

with regard to

How FRAV and VMAD principles
are reflected in ALKS

Reflection of FRAV/VMAD fundamentals in ALKS Regulation

(a) Correspondence with relevant FRAV general functional requirements

(b) Correspondence with relevant VMAD validation methods

(a) Correspondence with relevant FRAV general functional requirements

Five main aspects of ADS performance as identified by FRAV	Are they reflected in the ALKS approach and the proposed amendments?
1. ADS should drive safely. (Ensure safe behavior of the ADS as "the driver")	Par. 5.1.1. „shall not cause any collisions that are reasonably foreseeable and preventable" Par. 5.2.4. stationary obstacles Par. 5.2.5.1. decelerating lead vehicle Par. 5.2.5.2. cutting-in vehicle Par. 5.2.5.3. crossing pedestrian
2. ADS should interact safely with the user. (Ensure safe use of ADS and safe interactions with the user such as transfers of control, user override, etc.)	Par. 5.4. Transition demand Par. 6.1. Driver Availability recognition system Par. 6.2. Activation, Deactivation and Driver Input Par. 6.3. System override Par. 6.4. Information to the Driver
3. ADS should manage safety-critical situations. (Differentiate between normal driving and emergency situations to ensure safe responses to the latter)	Par. 5.2.5. Collision Avoidance capability Par. 5.3. Emergency Manoeuvre
4. ADS should safely manage failure modes. (Ensure safe responses to system malfunction, physical damage, etc.)	Par. 5.1.1. „manage all situations including failures" Par. 5.1.6. Self-Checks
5. ADS should maintain a safe operational state. (Ensure safety throughout the useful life of the ADS, such as safety-critical updates, responses to obsolescence, end of production, etc.)	Par. 5.1.9. Safety and Compliance over lifetime of the system

(a) Correspondence with relevant FRAV general functional requirements

40 inter-related safety topics as identified by FRAV	Are they reflected in the ALKS approach and the proposed amendments?
1. The ADS should perform the entire Dynamic Driving Task.	"5.1.1. The activated system shall perform the DDT […]"
2. The ADS should control the longitudinal and lateral motion of the vehicle.	5.2.1. lateral motion 5.2.3. speed and distance control 5.2.4. + 5.2.5. reaction to obstacles
3. The ADS should recognize the ODD conditions and boundaries of the ODD of its feature(s).	6.2.3. preconditions for activation „5.4.1. The activated system shall recognise all situations in which it needs to transition the control back to the driver."
4. The ADS should detect, recognize, classify, and prepare to respond to objects and events in the traffic environment.	7. Object and Event Detection 5. Response to detected objects and events
5. The ADS should respect traffic rules.	"5.1.2. The activated system shall comply with traffic rules relating to the DDT in the country of operation."
6. The ADS should interact safely with other road users.	Base text: Par. 5.3.3.2., 5.4.3.1., 5.5.1. activation of hazard warning lights LC: Par. 5.2.6.4. indicate a lane change procedure to other road users
7. The ADS should adapt its behavior in line with safety risks.	Transition: Initiate MRM immediately in case of severe failure MRM: Perform lane change or bring vehicle to standstill in lane
8. The ADS should adapt its behavior to the surrounding traffic conditions.	5.2.2. reaction to vehicles driving beside 5.2.3. distance to a vehicle in front
9. The ADS driving behavior should not disrupt the flow of traffic.	Base text 5.1.2. comply with traffic rules LC proposal: Permitting the ALKS to perform a LC during an MRM
10 The ADS behavior should not be the critical factor in causation of a collision.	„5.1.1. The activated system shall not cause any collisions that are reasonably foreseeable and preventable."

(a) Correspondence with relevant FRAV general functional requirements

40 inter-related safety topics as identified by FRAV	Are they reflected in the ALKS approach and the proposed amendments?
11. Activation of an ADS feature should only be possible when the conditions of its ODD have been met.	6.2.3. preconditions for activation
12 The ADS should signal when conditions indicate a probable ODD exit.	5.4.2.1. transition in case of a planned event
13. The user should be permitted to override the ADS to assume full control over the vehicle.	6.2. Activation, Deactivation and Driver Input 6.3. System override
14. The ADS should safely manage transitions of control to the user.	5.4. Transition demand and system operation during transition phase
15. Prior to a transition of control to the user, the ADS should verify the availability of the user to assume control.	6.1.3. Driver availability
16. Pursuant to a transition, the ADS should verify full control of the vehicle by the user prior to deactivation.	6.2.5. Deactivation of the system 6.2.5.1. Deactivation by input to driving controls
17. The ADS should tolerate user input errors.	6.2.4., 6.3.1. Protection against unintentional deactivation
18. The ADS should provide feedback to the user on its operational status.	6.4. Information to the driver
19. The ADS should warn the user of failures to fulfill user roles and responsibilities.	6.1.3.1. Warning in case of detected driver unavailability
20. The user should be provided with information regarding user roles and responsibilities for the safe use of the ADS.	Appendix 1 to Annex 1 – 10. Information provisions to users
21. ADS vehicles that may operate without a user-in-charge should provide means for occupant communication with a remote operator.	n.a.
22. Upon completion of an MRM, a user may be permitted to assume control of the vehicle.	6.2. Activation, Deactivation and Driver Input 6.3. System override apply also to the MRM

(a) Correspondence with relevant FRAV general functional requirements

40 inter-related safety topics as identified by FRAV	Are they reflected in the ALKS approach and the proposed amendments?
23. The ADS should recognize and respond to road-safety agents.	n.a. to highway domain, in principle: 5.2.4. and 5.2.5.3. reaction to stationary and crossing pedestrians
24. The ADS should mitigate the effects of road hazards.	5.2.4. reaction to stationary obstacles blocking the lane
25. The ADS should execute a safe fallback response as conditions warrant.	5.5. MRM
26. In the absence of a fallback-ready user, the ADS should automatically achieve a Minimal Risk Condition (MRC).	5.5. MRM
27. The ADS should place the vehicle in an MRC in the event of a failed transition of full control to the user.	5.5. MRM
28. The ADS should achieve an MRC prior to deactivation.	"5.5.4. A minimum risk manoeuvre shall only be terminated once the system is deactivated or the system has brought the vehicle to a standstill."
29. The ADS should signal its intention to place the vehicle in an MRC.	6.4.1. indication of an MRM to the driver 5.5.1. indication of an MRM to other road users
30 The ADS should safely manage short-duration ODD exits.	5.4.2.2. transition in case of an unplanned event
31. Pursuant to a collision, the ADS should stop the vehicle and deactivate.	5.1.1. bring vehicle to standstill if involved in a detected collision
32. The ADS should detect system malfunctions and abnormalities.	5.1.6. system self-checks

(a) Correspondence with relevant FRAV general functional requirements

40 inter-related safety topics as identified by FRAV	Are they reflected in the ALKS approach and the proposed amendments?
33.	The ADS should execute a safe fallback response upon detection of a failure that compromises performance of the DDT.	"5.4.2.3 In case of any failure affecting the operation of the system, the system shall immediately initiate a transition demand upon detection."
34.	Provided a failure does not compromise ADS performance of the entire DDT, the ADS should respond safely to the presence of a fault in the system.	"5.4.3. During the transition phase the system shall continue to operate."
35.	The ADS should signal faults and resulting operational status.	6.4.1. indication of failure to the driver
36.	The ADS should be permanently disabled in the event of obsolescence.	"5.1.9. When the system can no longer meet the requirements of this Regulation, it shall not be possible to activate the system."
37.	Pursuant to a collision and/or a failure detected in DDT-related functions, ADS activation should not be possible until the safe operational state of the ADS has been verified.	6.2.3. activation only when the system is free from faults relevant to the operation of the system
38.	The ADS should signal required system maintenance to the user.	n.a. – regular vehicle maintenance
39.	The ADS should be accessible for the purposes of maintenance and repair to authorized persons.	n.a. – ALKS if fitted to a regular vehicle
40.	ADS safety should be ensured in the event of discontinued production/support/maintenance.	"5.1.9. When the system can no longer meet the requirements of this Regulation, it shall not be possible to activate the system. The manufacturer shall declare and implement a process to manage the safety and continued compliance of the ALKS system over lifetime."

(a) Correspondence with relevant FRAV general functional requirements

➢ All safety topics identified by FRAV are reflected in the ALKS regulatory text.

➢ As long as new provisions for speed extension and lane change don't violate any of these base provisions, and additionally ensure using the following safety topics with specific relevance as a guidance, ALKS extension will remain harmonized with the approach introduced by FRAV.

	Safety topics with special relevance to speed extension and lane change
6.	The ADS should interact safely with other road users.
7.	The ADS should adapt its behavior in line with safety risks.
9.	The ADS driving behavior should not disrupt the flow of traffic.
24.	The ADS should mitigate the effects of road hazards.
25.	The ADS should execute a safe fallback response as conditions warrant.

(b) Correspondence with relevant VMAD validation methods

- VMAD was introduced to validate safety of the system when system behavior is so complex that defining specific requirements and dedicated test cases covering all relevant scenarios is no longer feasible.

- ALKS is restricted to a limited domain – motorways with infrastructural separation where pedestrians and cyclists are by design prohibited.

- ALKS functionality is regulated in detail, so that the capability of the system is well known.

- Therefore the variety of scenarios relevant to the ALKS is limited as well and only a subset or adapted set of methods introduced by VMAD should be reasonably applied to an ALKS, even when a lane change function is included.

(b) Correspondence with relevant VMAD validation methods

Audit and Assessment
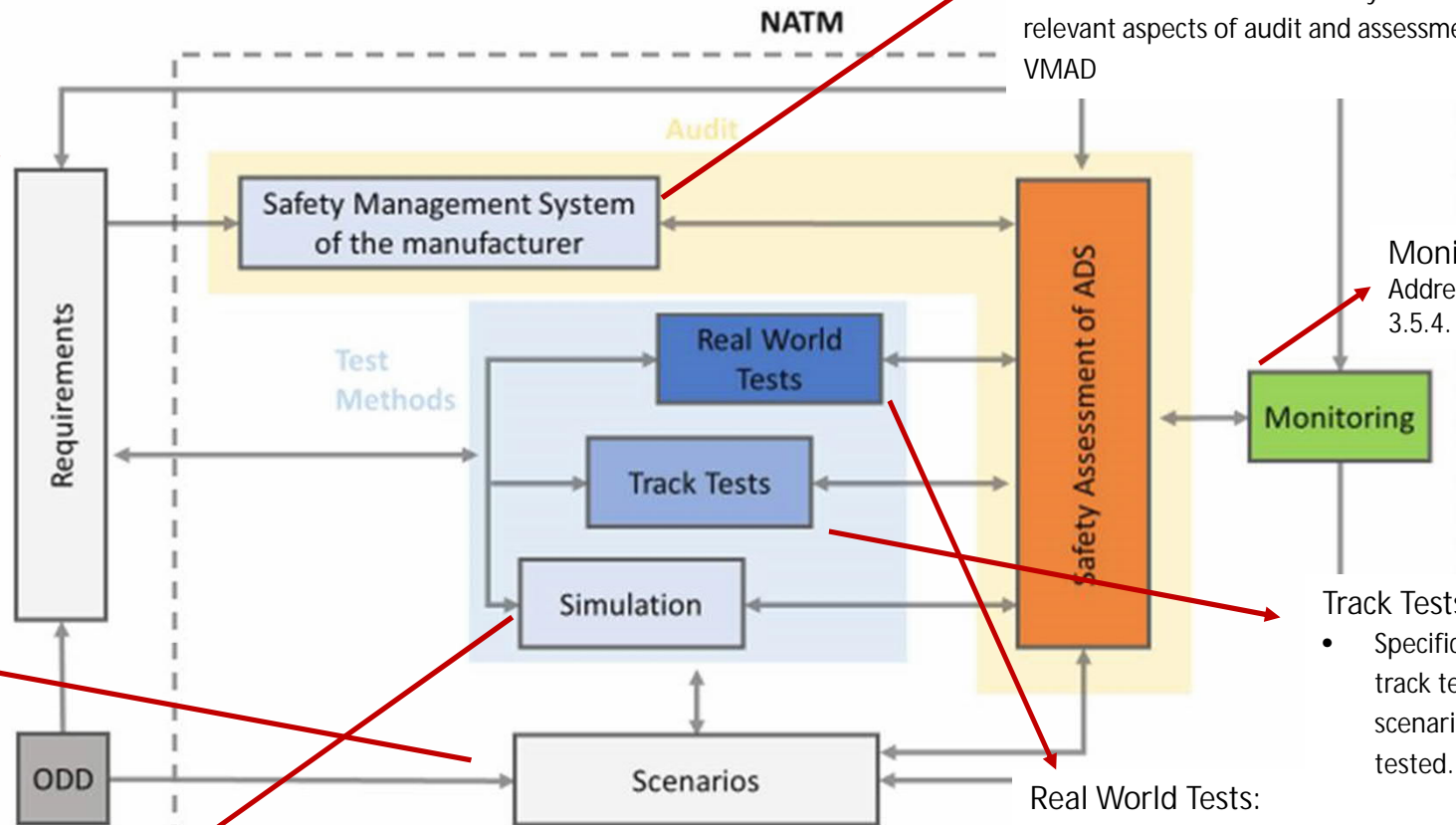Annex 4 of ALKS was drafted by VMAD and includes all relevant aspects of audit and assessment identified by VMAD

Requirements:
- Requirements are specific and detailed,
- No requirement relies on e.g. a scenario data-base for further clarification of its actual meaning

Monitoring:
Addressed by Annex 4, Par. 3.5.4.

NATM

Audit

Safety Management System of the manufacturer

Requirements

Test Methods

Real World Tests

Track Tests

Simulation

Safety Assessment of ADS

Monitoring

ODD

Scenarios

Track Tests:
- Specific parameters of required track tests are left open, so any scenario could potentially be tested.

Scenarios:
- Scenarios relevant to the highway use case are very limited and all relevant scenarios are adressed by the provisions of Annex 5.
- Additionally the Annex on Traffic disturbance critical scenarios gives guidance on scenario assessment.

Real World Tests:
- Required as part of Annex 5.
Since most scenarios relevant to the operation of ALKS can be demonstrated during track testing, there is not so much benefit from extensive real world testing

Simulation:
- Simulation is described as a tool used to demonstrate compliance during the Audit.
- While an important development tool, compliance of ALKS can be demonstrated on the basis of track testing, since the variety of scenarios remains limited.

(b) Correspondence with relevant VMAD validation methods

Comparison of scenarios identified by VMAD for a highway use case and those adressed by ALKS:

Scenario family		Sub-scenario	Corresponding ALKS provision / test method
1. Nominal driving	1-1. Perform lane keeping	a. Driving straight	Annex 5, Par. 4.1. Lane Keeping
		b. Manoeuvring a bend	Annex 5, Par. 4.1. Lane Keeping
2. Interaction with other vehicles	2-1. Perform lane change	a. Ego vehicle performing lane change with vehicle behind	Annex 5, proposal for Par. 4.7. Lane Change
		b. Merging at highway entry	Annex 5, proposal for Par. 4.7. Lane Change
		c. Merging at lane end	Annex 5, proposal for Par. 4.7. Lane Change
		d. Merging into an occupied lane	Annex 5, proposal for Par. 4.7. Lane Change
	2-2.Critical (Emergency) braking scenarios during lane keeping	e. Impassable object on intended path	Annex 5, Par. 4.2. Road User or object blocking the lane
		f. Passable object on intended path	Annex 5, Par. 4.2. Road User or object blocking the lane
		g. Lead vehicle braking	Annex 5, Par. 4.3. Following a lead vehicle
		h. Approaching slower/stopped LV	Annex 5, Par. 4.3. Following a lead vehicle
		i. Cut-in in front of the ego vehicle	Annex 5, Par. 4.4. Lane Change of other vehicle into lane
		j. Cut-out in front of the ego vehicle	Annex 5, Par. 4.5. Stationary obstacle after lane change of lead vehicle
		k. Detect and respond to swerving vehicles	Annex 5, Par. 4.1. Lane Keeping

(b) Correspondence with relevant VMAD validation methods

Comparison of scenarios identified by VMAD for a highway use case and those adressed by ALKS:

Scenario family	Sub-scenario	Corresponding ALKS provision / test method
3. Detect and response to traffic rules and road furniture	a. Speed limit sign	Annex 5, Par. 5.4. Real-world test
	b. Signal lights	Annex 5, Par. 5.3. Additional scenarios
	c. Drive through tunnel	Annex 5, Par. 5.3. Additional scenarios
	d. Toll	Annex 5, Par. 5.3. Additional scenarios
	e. Conventional obstacles	Annex 5, Par. 4.2. Road User or object blocking the lane
[4.Country specific road geometry]	a. Intercepter	Annex 5, Par. 5.3. Additional scenarios
[5. Unusual situation]	a. Wrong way driver (oncoming)	Annex 5, Par. 5.3. Additional scenarios