Consolidated draft texts, post 12th ADS-IWG meeting in Finland,

for a new UN GTR and UN Regulation on Automated Driving Systems,

submitted by SMS, Safety Case, DDT, User Interaction,Testing and ISMR OPIs based on the ADS-12-03

Updated to reflect latest versions of ADS Workshop outputs (31 July 2025)

Please Note:

1. *This draft document reflects the discussions and contributions made up to the 12th session of the ADS Informal Working Group (ADS-IWG), held in Helsinki.*
2. *It aims to capture the progress achieved so far and provides a consolidated view of the evolving text from OPIs perspective.*
3. *Additionally, it contains the agreed draft text following the 8th ADS Workshop.*

Exclusion

- No review has been carried out for the following sections (included in the ADS-12-03) under the responsibility of the ADS workshop:
    - I, II, Introduction and purpose of the GTR
    - Introduction, Application for approval and Approval for UNR

Note: the Figure 1concerning the multipillar approach should also be revised as per the discussion in the ADS-12-03

However, the following changes are made based on the Helsinki discussion

- GTR: introduction
    - point 39, from fleet data to in service data as per agreement on ADS-12-37 (OICA/CLEPA)
    - point 43b, from Minimal to Mitigated as per SAE proposal for MRC (text is in square bracket)
      Note: Several points in the introduction should also be updated to reflect the agreement to use the definition of *situation* in addition to scenario (ADS-12-23 (OPI)). (This is an action for ADS workshop)
- UNR: Scope, inclusion of Cat L6 and L7

How to read this document:

- **This document is completely clean with the text in black and white cells and without square brackets or strikethrough text, with the following exceptions:**
  1) **Red text** is only used for the sections under responsibility of the ADS workshop, for which some changes has been made by OPIs (as specified above) to reflect discussions/agreement in the 12th ADS IWG
  2) **Cell in red combined with text in square bracket** is used for open items for which no agreement is achieved yet and there is need to discuss in the next ADS-IWG (as per OPIs opinion).
  3) **Text in square bracket, but with cell in white**, is used for:
     a. changes made by the OPIs, but not included in the ADS-12-03 or not directly included in one of the proposals submitted for the 12th ADS-IWG. These changes have been made to reflect discussions and agreements in the ADS-IWG meetings (e.g., changes from scenarios to situation that were not mentioned in the proposal ADS-12-23)
     b. contributions from other groups that are still under discussion (e.g., contributions from DSSAD)
     c. cases in which 2 alternative words were possible for which the OPIs has taken the decision (e.g., user vs passenger in the 5.2.2.1.2. c) or where a word was missing, or where cross-reference should be added

     As per OPIs opinion, it is not strictly necessary to discuss these changes in the next ADS-IWG if not explicitliy requested by ADS-IWG members.

Note: The proposal on confirmatory testing 7.3.3.2.1, 7.3.3.3.1, 7.3.3.4.1 and the DSSAD Annex has some strikethrough text to reflect the current satus of the discussion

Note for Secretaries

- **General considerations:**

The following points are listed for actions to be taken by the Sec. and to facilitate his task:

1) UNR: there are two sections 4, one for the Approval (that we have renamed as 3B) and the other is for General requirement
2) UNR/GTR: OPIs have deleted the *Annex 6: Use-case for Nominal, Critical, and Failure Situation Mapping*. OPIs think that it was a placeholder for the work done by the testing group that is now merged in the Annex5.
3) UNR: In the approval section the requirements 4.1.2.1 and 4.1.2.2 have been added (these cells are filled in red with the text in square bracket), because this is the compromise proposal on confirmatory testing submitted by the testing OPI (Action: China will provide a feedback/confirmation)
4) UNR/GTR: OPIs advise to review the general requirements section to ensure consistency with the revised text in the sections 5,6,7
5) UNR/GTR: As per the discussion in Helsinki, the lifecycle is divided in 3 main phases (Desing and Development, Production and Post Deployment) even if it is acknowledged that there are subphases such as operation or decommissioning in the post-deployment. However, there is no need to provide further details in the Reg. OPIs advise to keep the text consistent with this approach in all the sections.

6) UNR/GTR: OPIs want to emphasise that the 3.11 (i.e., definition of DSSAD) will not be discussed in the DSSAD group without the formal proposal submitted in the EDR/DSSAD group.

- **Missing text**
7) UNR/GTR: Some requirements were missing from the ADS-12-03 even though they were supposed to be there from agreements achieved in previous meetings of the ADS-IWG. They have been added with the following numbering in the OPIs version:
    a. General requirement section: 4.2.1, **4.4.3.1 and subparagraphs, 4.4.5.1.1, 4.4.5.4.** (The ones in bold were missing also in the ADS-10-05, but included in the earlier version **ADS-08-04r1**)
    b. Section 5: 5.1.4.4., 5.2.2.3.9. 5.2.2.3.12.,
    c. Section6: 6.1.4.2 b) and c)
    d. Section 7: 7.3.1.4 a),b),d) h), **7.3.2 and subparagraphs, and 7.3.3 and subparagraphs**. The ones in bold were missing also in the ADS-10-05, but included in the earlier version **ADS-08-04r1**)
    e. Annexes: Annex2/4 and Annex3/5

- **Definition or Requirement deletions**
8) UNR/GTR: Some definitions and requirements have been deleted. The numbering below refers to ADS-12-03. (Note: most of these changes are also included in the version ADS-12-03_rev meeting Day5 shared by the chair, Cristina Galassi):
    a. 3.7 ADS off, 3.8 ADS on, 3.9 ADS standby, 3.18 DDT fallback (they are all removed as per Helsinki agreement)
    b. Note 37 and Note 47 (they are all removed as per Helsinki agreement. The note 47 shall be considered for the Interpretation Document)
    c. 5.2.4.10. (removed because it was a duplication)
    d. 6.1.1.2 f) and g) (moved to another req. as per Helsinki agreement), 6.1.2.3. (moved to another req. as per Helsinki agreement), 6.1.2.4. (moved to another req. as per Helsinki agreement), 6.1.2.5 and 6.1.2.5.1/2 (removed because not discussed), 6.1.5.2. i) (it is combined with the h as per Helsinki agreement))
    e. 6.2.2.2. (removed as per OPI testing proposal)
    f. 7.1.2 and subparagraphs, 7.1.3 and subparagraphs (as per Helsinki agreement)

UN GTR	UN Regulation
Contents	
I. Statement of technical rationale and justification	
A. Introduction	0. Introduction (for Information)
B. Procedural background	
C. Technical background	
D. Principles for developing the GTR	
E. Technical rationale and justification	
F. Existing regulations, directives, and international voluntary standards	
G. Benefits and costs	
II. Text of the Regulation	
1. Purpose	
2. Scope	1. Scope
3. Definitions	2. Definitions
	3. Application for approval
	3B. Approval
4. General requirements	4. General requirements
5. ADS requirements	5. ADS requirements
6. Manufacturer requirements	6. Manufacturer requirements
7. Compliance assessments	7. Compliance assessments
	8. Modification and extension of approval of a vehicle type
	9. Conformity of production
	10. Penalties for non-conformity of production

UN GTR		UN Regulation	
		11.	Production definitively discontinued
		12.	Names and addresses of the designated technical services responsible for conducting approval tests and of the Type Approval Authorities
Annexes			
		Annex 1.	Communication
		Annex 2.	Examples of arrangements of approval marks
Annex 1.	List of Reportable Occurrences by Reporting Type	Annex 3.	List of Reportable Occurrences by Reporting Type
Annex 2.	In-Service Reporting Template: Short-term Reporting	Annex 4.	In-Service Reporting Template: Short-term Reporting
Annex 3.	In-Service Reporting Template: Periodic Reporting	Annex 5.	In-Service Reporting Template: Periodic Reporting
Annex 4.	Threshold Definitions	Annex 6.	Threshold Definitions
Annex 5.	ODD-based Behavioural Competencies and Scenario Identification Approach	Annex 7.	ODD-based Behavioural Competencies and Scenario Identification Approach
Annex 6.	Data Storage Systems for Automated Driving	Annex 8.	Data Storage Systems for Automated Driving
I.	Statement of technical rationale and justification		
A.	Introduction	0.	Introduction (for Information)
		0.1.	[Where automated lane keeping features are also described in UNECE Regulation 157, the corresponding requirements should be taken into consideration, insofar as they are not already covered by this regulation.]

UN GTR	UN Regulation
1. With the rapid development of Automated Driving System (ADS) technology, ADS vehicles hold great potential to improve road safety and enhance mobility options for numerous road users. ADS are poised to significantly change the nature of road transport. They also pose many novel safety risks that must be effectively addressed by manufacturers and the international regulatory community.	
2. The introduction of ADS presents many new, unique challenges for the development of vehicle regulation. Governments around the world are facing the problem of how to formulate effective regulatory measures. To ensure ADS safety, the safety regulators require new concepts, tools, and methodologies in addition to those historically used for previous vehicle technologies and systems.[1]	
3. WP.29 recognizes that for automated vehicles to fulfil their potential, in particular to improve road transport, they must be placed on the market in a way that reassures road users of their safety. If automated vehicles confuse users, disrupt road traffic, or otherwise perform poorly, then they will fail to improve road transport outcomes. Therefore, there is an urgent need for regulatory measures, to ensure the safety of automated vehicles that are deployed on public roads, and to promote collaboration and communication amongst those involved in their development and oversight.	

---

[1] ECE/TRANS/WP.29/2024/39.

UN GTR	UN Regulation
4. Technical provisions, guidance resolutions and evaluation criteria for automated vehicles will, to the best extent possible, be performance based, technology neutral, and based on state-of-the-art technology, while avoiding restricting future innovation.[2] Automated vehicle systems, operating in automated mode in their respective Operational Design Domain (ODD) shall not cause any traffic accidents resulting in injury or death that are reasonably foreseeable and preventable. Based on these principles, this GTR sets out a series of vehicle safety provisions to address the safe deployment of ADS equipped vehicles.[3]	
5. It is important to note that the diversity of ADS vehicle configurations and the characteristics and constraints of their ODD present challenges in establishing harmonized requirements for worldwide use. At the same time, the complexity of driving also presents challenges to the assessment of ADS performance across the diversity of ODDs.[4]	
6. This GTR aims to provide a harmonized methodology, incorporating high-level requirements that address the unique nature and safety challenges associated with ADS technology as well as a multi-pillar approach to ensure comprehensive, effective and efficient validation of ADS safety.[5]	
7. This GTR is based on the collaborative efforts of the Informal Working Group on Automated Driving Systems (IWG ADS) and the Working Party on automated and Connected Vehicles (GRVA) workshops on Automated Driving Systems.	

---

[2] ECE/TRANS/WP.29/2019/34/Rev.2.

[3] ECE/TRANS/WP.29/2019/34/Rev.2.

[4] GRVA-18-50.

[5] GRVA-18-50.

UN GTR	UN Regulation
B. Procedural background	
8. In 2015, the World Forum for Harmonization of Vehicle Regulations (WP.29) established a programme under the Intelligent Transport Systems (ITS) informal working group to focus on automated driving (ITS/AD).	
(a) During its 174th (March 2018) session, WP.29 approved a proposal from the ITS/AD informal group for a "Reference document with definitions of Automated Driving under WP.29 and the General Principles for developing a UN Regulation on automated vehicles".	
(b) In March 2018, ITS/AD established a Task Force on Automated Vehicle Testing (TFAV) "to develop a regulatory testing regime that assesses a vehicle's automated systems so as to realise the potential road safety and associated benefits under real life traffic conditions".	
(c) TFAV established subgroups to consider AV assessment methods:	
(i) Physical certification tests and audit;	
(ii) Real-world test drive.	

UN GTR	UN Regulation
9. At the 178th session, WP29 adopted the Framework document on automated vehicles (WP.29/2019/34/Rev.2), herein referred to as the Framework document and the Terms of Reference (ToRs) (WP.29/1147/Annex VI). The Framework Document provides "guidance to WP.29 subsidiary Working Parties (GRs) by identifying key principles for the safety and security of automated vehicles of levels 3 and higher". The Framework Document allocated work on these WP.29 priorities across several informal working groups, including Functional Requirements for Automated Vehicles (FRAV) and Validation Methods for Automated Driving (VMAD). The Framework document instructed VMAD and FRAV to develop a 'new assessment/test method for automated driving' (NATM) for consideration during the 183rd (March 2021) session of WP.29.	
10. VMAD's mandate under the ToRs was to develop assessment methods, including scenarios, to validate the safety of automated systems based on a multi-pillar approach including audit, simulation/virtual testing, test track, and real-world testing. FRAV developed functional (performance) requirements for automated vehicles. Based on the work of both groups the NATM master document, which outlines a conceptual framework for validating the safety of automated driving systems, was developed. The first version of this document was adopted at the 184th session (June 2021) of WP29 (ECE/TRANS/WP.29/1159). The second version was submitted to the 12th session (January 2022) of GRVA. [6]	

---

[6] ECE-TRANS-WP29-GRVA-2022-02e

UN GTR	UN Regulation
11. Building on this conceptual work, VMAD and FRAV were instructed by WP29 to undertake the development of the NATM guidelines. This document was developed to provide direction to developers and contracting parties of the 1958 and the 1998 UN vehicle regulations agreements on recommended procedures for validating the safety of ADS.[7]	
12. WP.29 further directed FRAV and VMAD to collaborate and deliver a consolidated FRAV/VMAD submission (requirements and assessment methods) for its June 2024 session. WP.29 approved the integrated FRAV/VMAD guidelines during the June 2024 session.[8]	
13. At the 191st session of the World Forum for Harmonization of Vehicle Regulations and the 68th session of the Executive Committee of the 1998 Agreement in Nov. 2023, WP.29 adopted a proposal for the regulatory approach for Automated Driving Systems (WP.29-191-30/Rev.1). This proposal included the creation of (i) a new Informal Working Group on Automated Driving Systems (IWG ADS) and (ii) Working Party on automated and Connected Vehicles (GRVA) workshops to launch and undertake the work on regulatory activities for such systems. This decision is noted in the report of the WP.29 191st session.[9] WP.29's administrative council (AC.3) approved the request for authorization of a new UN GTR on ADS in March 2024 as noted in Annex IV of the report on the 192nd session of WP.29.[10]	

---

[7] ECE/TRANS/WP.29/1159

[8] ECE/TRANS/WP.29/2024/39

[9] ECE/TRANS/WP.29/1175

[10] ECE/TRANS/WP.29/1177

UN GTR	UN Regulation
14. At the eighteenth session of the GRVA, the regulatory approach for Automated Driving Systems, as adopted by WP.29, was discussed. GRVA deliberated on the establishment of a bureau composed of representatives from Canada, China, the European Commission, the United Kingdom, Japan, and the United States to lead the activity. GRVA adopted the draft terms of reference for the IWG on ADS and the workshops on ADS, and submitted them to WP.29.[11]	

---

[11] GRVA-18-41/Rev.2 and GRVA-18-42/Rev.2.

UN GTR	UN Regulation
15. At the 192nd session of the World Forum for Harmonization of Vehicle Regulations and the 69th session of the Executive Committee of the 1998 Agreement in March 2024, WP.29 agreed that the IWG on ADS would be sponsored and led by Canada, China, European Commission, Japan, United Kingdom of Great Britain and Northern Ireland and the United States of America. WP.29 also noted that the secretariat services would be provided by the representatives of AAPC, OICA, JASIC and SAE International. The IWG on ADS was tasked with developing the technical requirements for the ADS regulation for Contracting Parties under the 1958 and 1998 Agreements. The Workshops focused on the development of the administrative requirements for the ADS regulation, as well as an interpretation document to assist in the implementation of these regulations. Two ambassadors (from Australia and the Netherlands) were tasked to align the activities of the IWG on ADS and the Workshops, and evaluate the progress of both activities.[12] During this session, WP.29 adopted an amendment to the Framework Document on automated vehicles to take into account these new activities.[13]	

---

[12] ECE/TRANS/WP.29/2024/38 and ECE/TRANS/WP.29/AC.3/62
[13] ECE/TRANS/WP.29/2024/33 based on informal document WP.29-191-31

UN GTR	UN Regulation
16. During the first session of the IWG on ADS the work plans and a draft structural framework referring to the ADS GTR and UNR content were explained based on specific sections, particularly "General requirements," "Performance requirements/Test specifications," and "Assessment/Test procedures."[14] It was agreed to appoint "Officers of Principal Interest" (OPI) for each section, who would act as points of contact and coordinators, receiving assistance from IWG on ADS experts. During the first session of the ADS workshop OPIs were also selected to develop the text for the administrative provisions for the ADS GTR and UN Regulation.	
17. The initial objective of the IWG was transposition of the ADS guidelines (1958 and 1998 Agreement) into common regulatory provisions, focusing first on requirements and then on assessment methods/processes.[15] This text is derived from the specific provisions and annexes received from the June 2024 Functional Requirements for Automated Vehicles (FRAV) - Validation Method for Automated Driving (VMAD) Informal Working Group Integrated Document[16] under the Working Party on automated and Connected Vehicles (GRVA) and workshops for the generation of the draft UN Global Technical Regulation on ADS. The second phase involved transposing the common provisions into UN GTR and UN Regulation texts and integrating the GRVA ADS workshop outcomes into the text.	

---

[14] ADS-01-03

[15] WP.29-194-ADS/Add.1

[16] ECE/TRANS/WP.29/2024/39

UN GTR	UN Regulation
18. The IWG also received reports on the work of other informal groups, including Automated Vehicle Categorisation (AVC), Event Data Recorders and Data Storage Systems for Automated Driving (EDR/DSSAD), Regulation Fitness for Automated Driving Systems (FADS), and the GRVA ADS WS. The IWG noted the need for consistency across all these activities with the ADS regulations.[17]	
19. The text was further refined from subsequent discussions at multiple IWG on ADS sessions and GRVA workshops. This included consolidation of common provisions of the text based on the work of the IWG OPIs. The consolidated common provisions document provided a baseline document that was then separated into a draft GTR and a draft UNR.	
C. Technical background	
20. The key subject of this GTR is the ADS). The definition of ADS "means the vehicle hardware and software that are collectively capable of performing the entire Dynamic Driving Task (DDT) on a sustained basis."[18] When the ADS is in operation, the DDT is "always performed in its entirety by the ADS, which means the whole of the tactical and operational functions required to operate the vehicle". [19]	

---

[17] GRVA-21-44/Add.1

[18] ECE/TRANS/WP.29/2024/39 paragraph 3.1.2. This definition is based on SAE J3016 and ISO/PAS 22736 (Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles). These standards define levels of driving automation based on the functionality of the driving automation system feature as determined by an allocation of roles in DDT and DDT fallback performance between that feature and the (human) user (if any). The term "Automated Driving System" is used specifically to describe a Level 3, 4, or 5 driving automation system.

[19] ECE/TRANS/WP.29/2024/39 paragraph 3.1.11.1.

UN GTR	UN Regulation
Section C.1 describes what the DDT consists of. Section C.2 describeq the need to demonstrate the technical competency of the ADS. Section C.3 describes the various methods used to validate the safety of the ADS.	
1. ADS performs all tactical and operational functions of driving	
21. Driving consists of three categories of functions: strategic, functional and operational. The real-time tactical and operational functions required to operate a vehicle in on-road traffic are collectively known as the DDT, which does not include strategic functions. Strategic functions include activities such as determining a trip destination that do not involve vehicle dynamic control.	
The tactical level involves manoeuvring the vehicle in traffic during a trip, including perceiving and assessing of the driving environment, deciding and planning on a specific manoeuvre.	
22. Tactical functions include but are not limited to manoeuvre planning and execution, enhancing conspicuity (lighting, signalling, gesturing, etc.), and managing interactions with other road users. Tactical functions generally occur over a period of seconds.	
23. Operational functions include but are not limited to lateral vehicle motion control (steering) and longitudinal vehicle motion control (acceleration and deceleration). This operational effort involves split-second reactions, such as making micro-corrections while driving. [20]	

---

[20] ECE/TRANS/WP.29/2024/39 Annex 1 paragraph 6, 8, 9, 11-15.

UN GTR	UN Regulation
24. The DDT definition explains that these functions can be grouped into three interdependent categories: sensing and perception, planning and decision, and control. [21]	
25. Sensing and perception include: (a) Monitoring the driving environment via object and event detection, recognition, and classification; (b) Perceiving other vehicles and road users, the roadway and its fixtures, objects in the vehicle's driving environment and relevant environmental conditions; (c) Sensing the ODD boundaries, if any, of the ADS feature; (d) Positional awareness.	
26. Planning and decision include: (a) Predicting actions of other road users; (b) Response preparation; (c) Manoeuvre planning.	
27. Control includes: (a) Object and event response execution; (b) Lateral vehicle motion control; (c) Longitudinal vehicle motion control; (d) Enhancing conspicuity via lighting and signalling.	
2. ADS needs to demonstrate the competency of vehicle safety	
28. An ADS must demonstrate the competency to operate the vehicle safely, to respond to external conditions, and to manage internal failures.	

---

[21] ECE/TRANS/WP.29/2024/39 paragraph 3.1.11.1.

UN GTR	UN Regulation
29. Moreover, the ADS must be designed to ensure safe use and the safety of its users throughout the useful life of the vehicle.	
30. To ensure that the safety competency is demonstrated, an ADS might be expected to be assessed via a framework for the development of traffic scenarios.	
31. The framework would include nominal, critical and failure scenarios. The requirements of the rule intentionally avoid technical specifications and performance limits for specific scenarios because each traffic situation requires a response appropriate to its combination of elements, risks, and available options.	
32. Defining the performance criteria in critical scenarios could be difficult. In these cases, this could be done by using appropriate safety models to enable assessment of ADS performance within the limits of the safety models. [22]	

---

[22] ECE/TRANS/WP.29//202439 paragraph 4.2-4.6.

UN GTR	UN Regulation
33. As a general concept, the safety level an ADS should be at least the same or greater than a competent and careful human driver. This concept is important minimizing unreasonable safety risks to the ADS vehicle user(s) and other road users[23]. The manufacturer's safety case for the ADS and its features will include a description of the design processes used to implement the safety concept, and a structured presentation demonstrating through a body of evidence that the ADS and its features have undergone sufficient safety validation to ensure an absence of unreasonable risk in the ADS's performance.[24]	
3. Validating the safety of ADS	
34. Validating the ADS's capabilities is a highly complex task which cannot be done comprehensively nor effectively through one validation methodology alone. As a result, it is necessary to adopt a multi-pillar approach for the validation of ADS.	

---

[23] ECE/TRANS/WP.29/2024/39 paragraph 4.8.
[24] ECE/TRANS/WP.29/2024/39 paragraph 5.3.3.

UN GTR	UN Regulation
35. These various methodologies are intended for use in combination(s) to produce an efficient, comprehensive, and coherent assessment of ADS safety performance. Each of the testing methodologies possess their own strengths and limitations, such as differing levels of environmental control, environmental fidelity, scalability, and cost, which should be considered. In some cases, the application of more than one method could be necessary to assess the capability of an ADS to cope with range of situations that can arise in real-world traffic. The use of multiple methods allows for flexibility in the composition, sequencing, and application of testing across the diversity of ADS, while avoiding unnecessary redundancies and overlaps. Figure 1 below illustrates relationships across the ADS safety requirements, ODD analysis and scenario generation, and the validation pillars.[25]	
(a) Simulation/virtual Testing	
36. It uses different types of simulation toolchains to assess the compliance of an ADS with the safety requirements on a wide range of virtual scenarios including some which would be extremely difficult if not impossible to test in real-world settings. The aspect of credibility of simulation/virtual testing is included in this topic.[26]	
(b) Track testing	
36. It uses a closed-access testing ground with various scenario elements to test the capabilities and functioning of an ADS.[27]	

---

[25] ECE/TRANS/WP.29/39 paragraph 4.18.
[26] ECE/TRANS/WP.29/2022/57 IV. Paragraph 15.
[27] ECE/TRANS/WP.29/2022/57 IV. Paragraph 16.

UN GTR	UN Regulation
(c) Real world testing	
37. It uses public roads to test and evaluate the performance of ADS related to its capacity to drive in real traffic conditions.[28]	
(d) Audit/assessment procedures	
39. They establish how manufacturers will be required to demonstrate to safety authorities using documentation, their simulation, test-track, and/or real-world testing of the capabilities of an ADS. The audit will validate that hazards and risks relevant for the system have been identified and that a consistent safety-by-design concept has been put in place. The audit will also verify that robust processes/mechanisms/strategies (i.e., safety management system) that are in place to ensure the ADS meets the relevant safety requirements throughout the vehicle lifecycle. It shall also assess the complementarity between the different pillars of the assessment and the overall scenario coverage.[29]	
(e) In-service monitoring and reporting	
40. It addresses the in-service safety of the ADS after its placing on the market. It relies on the collection of in service data in the field to assess whether the ADS continues to be safe when operated on the road. This data collection can also be used to fuel the common scenario database with new scenarios from the field and to allow the whole ADS community to learn from major ADS accidents/incidents.[30]	

---

[28] ECE/TRANS/WP.29/2022/57 IV. Paragraph 17.
[29] ECE/TRANS/WP.29/2022/57 IV. Paragraph 18.
[30] ECE/TRANS/WP.29/2022/57 IV. Paragraph 19.

UN GTR	UN Regulation
Figure 1. Relationships across safety requirements, ODD analysis and scenario generation, and validation pillars	
4. Common Issues and Principles	
41. The following list of issues and principles guided discussions and activities on automated vehicles within WP.29 and each of its relevant subsidiary Working Parties. The aim was to capture the shared interests and concerns of regulatory authorities, provide the general parameters for work, and to provide common definitions and guidance.	

42. The following is a list of common principles with brief descriptions and explanations. It is expected these would form the basis for further development. Except for items n) and o), all these items have been identified in ECE/TRANS/WP.29/2029/34/Rev. 2.

a) *System Safety*: When in the automated mode, the automated vehicle should be free of unreasonable safety risks to the driver and other road users and ensure compliance with road traffic regulations.

b) *Failsafe Response*: The automated vehicles should be able to detect its failures or when the conditions for the [ODD] are not met anymore. In such a case the vehicle should be able to transition automatically (minimum risk manoeuvre) to a [mitigated] risk condition.

c) *Human Machine Interface (HMI) /Operator information*: Automated vehicle should include driver engagement monitoring in cases where drivers could be involved (e.g. takeover requests) in the driving task to assess driver awareness and readiness to perform the full driving task. The vehicle should request the driver to hand over the driving tasks in case that the driver needs to regain proper control of the vehicle. In addition, automated vehicle should allow interaction with other road users (e.g. by means of external HMI on operational status of the vehicle, etc.).

d) *Object Event Detection and Response (OEDR)*: The automated vehicles shall be able to detect and respond to object/events that may be reasonably expected in the [ODD].

e) *Operational Design Domain (ODD)] (automated mode)*: Manufacturers should document the ODD available on their vehicles and the functionality of the vehicle within the prescribed ODD. The ODD should describe the specific conditions under which the automated vehicle is intended to drive in the automated mode. The ODD should include the following information at a minimum: roadway

types; geographic area; speed range; environmental conditions (weather as well as day/night time); and other domain constraints.

f) *Validation for System Safety*: Manufacturers should demonstrate a robust design and validation process based on a systems-engineering approach with the goal of designing ADS free of unreasonable safety risks and ensuring compliance with road traffic regulations and the principles listed in this document. Design and validation methods should include a hazard analysis and safety risk assessment for the ADS, OEDR, as well as the overall vehicle design into which the ADS is being integrated. When applicable, the broader transport ecosystem should be included in this analysis. Design and validation methods should demonstrate the behavioural competencies an automated vehicle would be expected to perform during a normal operation, the performance during crash avoidance situations, and the performance of fall-back strategies. Test approaches may include a combination of simulation, test track, and on road testing.

g) *Cybersecurity*: The automated vehicle should be protected against cyber-attacks in accordance with established best practices for cyber vehicle physical systems. Manufacturers shall demonstrate how they incorporated vehicle cybersecurity considerations into ADSs, including all actions, changes, design choices, analyses and associated testing, and ensure that data is traceable within a robust document version control environment.

h) *Software Updates*: Manufacturers should ensure system updates occur as needed in a safe and secured way and provide for after-market repairs and modifications as needed.

i) *Event data recorder (EDR) and Data Storage System for Automated Driving vehicles (DSSAD)*: The automated vehicles should have an ability to

collect and record the necessary data related to the system status, occurrence of malfunctions, degradations or failures in a way that can be used to establish the cause of any crash and to identify the status of the automated driving system and the status of the driver. The identification of differences between EDR and DSSAD are to be determined.

42. Additional issues not listed in the currently agreed WP.29 priorities

j) *Vehicle maintenance and inspection*: Vehicle safety of in-use vehicles should be ensured through measures such as those related to maintenance and the inspection of automated vehicles etc. Additionally, manufacturers are encouraged to have documentation available that facilitates the maintenance and repair of ADSs after a crash. Such documentation would likely identify the equipment and the processes necessary to ensure safe operation of the automated vehicle after repair.

k) *Consumer Education and Training*: Manufacturers should develop, document and maintain employee, dealer, distributor, and consumer education and training programs to address the anticipated differences in the use and operation of automated vehicles from those of conventional vehicles.

l) *Crashworthiness and Compatibility*: Given that a mix of automated vehicles and conventional vehicles will be operating on public roadways, automated vehicle occupants should be protected against crashes with other vehicles.

m) *Post-crash AV behaviour*: automated vehicles should be able to return to a safe state immediately after being involved in a crash. Bringing the vehicle to a safe state includes considerations such as shutting off the fuel pump, removing motive power, moving the vehicle to a safe position off the roadway, and disengaging electrical power. It is vital that the ADS have the capability to engage with an operations centre or collision notification centre.

n) *Artificial Intelligence*: vehicle automation is based on a combination of hardware and software. The requirements in this regulation are based on the condition that this software does not include the use of online in-vehicle learning Artificial Intelligence. Artificial Intelligence can be used to analyse and improve ADS software in an engineering

environment. By means of a software update (over the air or connected) this update can be installed in the vehicle, again without in-vehicle learning features during operation of this version.

o)   ADS vehicles shall be in conformity with regional legislation (e.g. data protection, privacy).

UN GTR	UN Regulation
D. Principles for developing the global technical regulation	
44. The GTR provides a necessary first step to the safe deployment of ADS equipped vehicles on public roads as there are no existing global regulations nor regulations established in the Compendium of Regulations of the 1998 Agreement to support ADS deployment.	
45. Furthermore, industry has repeatedly indicated the need for regulations to be developed to support the deployment of vehicles equipped with ADS. This is necessary to prevent the fragmentation of regulatory approaches and avoid delaying the deployment of new technologies with the potential of improving road safety, promoting cleaner and greener transport, promoting social inclusion, and supporting economic growth.	
46. This GTR was developed on the principal of being performance based and technology neutral. The regulations have been developed in a manner that can be adapted to accommodate different types of vehicle certification processes.	
47. There are several GRVA subgroups active in the field of vehicle automation (EDR/DSSAD, TF AVC, TF FADS, CS/OTA). This first GTR is based on the information currently available from these subgroups. It provides worldwide harmonised procedures to set and verify compliance with minimum requirements for the safety of ADS and vehicles equipped with ADS with the notion that future improvements of the GTR are expected as ADS technologies continue to evolve. It takes into consideration existing and new data, research, and standards proposed by the contracting parties and industry.	

UN GTR	UN Regulation
E. Technical rationale and justification	
1. Application/Scope	
48. This UN GTR applies to vehicles of Category 1 and Category 2 based on the vehicle classification and definitions outlined in the 1998 Global Agreement Special Resolution No. 1 (S.R.1) with regards to their Automated Driving System.	
49. Given that high potential of the improvement for road traffic safety is expected for the vehicles equipped with ADS, this regulation will help to establish the minimum safety requirements for the manufacturers developing ADS and the adequate validation requirements for the approval authorities.	
50. Considering the diversity of ADS vehicle configurations, use cases and the characteristics of their ODDs (e.g. highway, urban, parking), this regulation will provide generic and high-level requirements to support the harmonization for ADS regulatory development worldwide and to support the introduction of innovations, allowing the industry to use state of the art technologies. At the same time, it will offer approval authorities a way to harmonize the safety level of ADS vehicles in the market.	
51. The generic requirements framework of this regulation will also allow further development of additional requirements for specific use cases or ADS features in the future.	
2. Rationale for safety management system	
52. The safety management system (SMS) is a systematic approach of the manufacturer to manage safety that encompasses and integrates human, organisational and technical factors:	

UN GTR	UN Regulation
(a) The human component ensures the ADS lifecycle is monitored by personnel with appropriate skills, training, and understanding to identify risks and appropriate mitigation measures. (b) The organisational component procedures and methods that help to manage the identified risks, understand their relationships and interactions with other risks and mitigation measures, and help to ensure that there are no unforeseen consequences. (c) The technical component using appropriate tools and equipment.	
53. An adequate SMS will incorporate all three factors to monitor and improve safety and help to control the identified risks. It should also include taking measures to monitor the vehicle during the in-service operation and to take corrective remedial action when necessary.	
54. To facilitate the approval authority's audit, the manufacturer should provide certain specific documentation to demonstrate that a SMS with robust processes to manage safety risks and to ensure safety throughout the ADS lifecycle (development, production, operational, decommissioning) has been established.	
55. This UN GTR requires the manufacturer's documentation to cover relevant aspects, including safety policy, risk management, design and development, production, post-deployment, safety assurance and safety promotion.	
3. Rationale for safety case	

UN GTR	UN Regulation
56. The UN GTR incorporates the concept of a safety case, where manufacturers are required to provide a structured argument supported by a body of evidence that provides a compelling, comprehensible, and valid case that the ADS is or will be free from unreasonable risk for a given application in a given environment.	
57. The Safety Case includes the following components: (a) The system description, which describes design elements of the ADS and the intended use case(s). (b) This includes schematics of hardware, software and system functions as well as contextual information such as the operational design domain, expected operating conditions and failure mitigation strategies. (c) The safety concept, which describes the hazard identification and mitigation measures designed into the ADS to meet requirements and achieve the goal of avoidance of unreasonable risk with regard to functional and operational safety. (d) This includes information and documentation necessary to describe the ADS covered by the safety case and how hazards identified by Safety Management System processes have been addressed. (e) Structured claims, argumentation, and evidence (including but not limited to validation tests) that affirms and demonstrates that the ADS meets applicable requirements and is free from unreasonable risks for the ADS vehicle user(s) and other road users. This includes the demonstration of credibility and suitability of test tools used in generating evidence and the explanation of the processes for reinforcing ADS safety throughout the life of the ADS.	

UN GTR	UN Regulation
58. The documentation provided as part of the safety case allows the relevant authority to assess the ADS and its respective features and determine whether the requirements of the GTR have been met.	
59. The safety case allows the relevant authority to determine whether the manufacturer has the capability to manage ADS safety throughout the lifecycle of the system.	
60. The safety case also includes requirements that the manufacturer review its safety case and remediate issues prior to certification/approval.	
4. Rationale for requirements concerning performance of the dynamic driving task	
61. As a general concept, the safety level of ADS shall be at least to the level at which a competent and careful human driver could minimize the unreasonable safety risks to the ADS vehicle user(s) and other road users.	
62. Driving involves real-time risk management under prevailing traffic scenarios which means a description of a sequence of driving situations that may occur during a given trip. Therefore, safe ADS performance of the dynamic driving task (DDT) depends upon the situations presented under each individual scenario and each scenario is associated with one or more behavioural competencies.	
63. This UN GTR establishes performance requirements for the evaluation of ADS driving behaviours under relevant traffic scenarios (nominal scenarios, critical scenarios, failure scenarios), at ODD boundaries and in fullbacks to an MRC. The manufacture shall use a process to derive behavioural competencies and scenarios that are ODD-relevant:	

UN GTR	UN Regulation
64. ADS performance of the DDT under nominal scenarios. The broad objective of the ADS is to not cause traffic accidents or disrupt traffic under nominal scenarios.	
65. ADS performance of the DDT under critical scenarios. The broad objective of the ADS is to not cause any traffic accidents resulting in injury or death that are reasonably foreseeable and preventable under critical scenarios.	
66. ADS performance of the DDT under failure scenarios. The broad objective of the ADS is to ensure the system safety and response to system failures that compromise the capability of the ADS to perform the DDT under failure scenarios.	
67. The safety case by the manufacturer demonstrates the application of the SMS to the ADS under assessment, including its design and intended uses (safety concept) and an evidence-based structured argument (safety claim, argument, evidence) that the ADS meets the safety requirements specified in this UN GTR.	
68. A complete safety case for the ADS and its features is required to be documented by the manufacturer. This includes a description of the design processes used to implement the safety concept, and a structured presentation demonstrating through a body of evidence that the ADS and its feature(s) have undergone sufficient safety validation to ensure there are no unreasonable risks in the ADS's performance.	
5. Rationale for requirements concerning ADS user interactions with the ADS	

UN GTR	UN Regulation
69. The requirements for safe interactions between users and ADS vary depending on user role, system design and tasks to be performed by the user during the use of the ADS equipped vehicle, such as:	
(a) ADS features that allow a user to take over manual-control of the DDT;	
(b) ADS features that do not allow a user to take manual control of the DDT.	
70. In addition to the requirements for the ADS, this UN GTR requires the manufacture to provide appropriate means in order to facilitate user understanding of the functionality and operation of the ADS. The means shall cover relevant aspects, such as operational description of the ADS features, capabilities, and limitations, instructions for the activation and deactivation of the ADS, general overview of non-driving-related activities (NDRA) allowed when an ADS feature is active where applicable, etc.	
6. Rationale for assessment of the safety case	
71. The evaluation (i.e. safety assessment) of the safety case provided by the manufacturer, including the safety of the ADS design is essential to determine the vehicle's ADS is safe by design and that the ADS has been sufficiently validated before market introduction.	
7. Rationale for In-service monitoring and reporting requirements	

UN GTR	UN Regulation
72. In addition to the pre-deployment assessment of ADS safety, the post-deployment assessment of ADS performance under the in-service monitoring and reporting (ISMR) pillar is required as well. The purpose of ISMR is to confirm the manufacturer's safety case and confirm the validation carried out by the manufacturer before market introduction as well as confirm safety during real-world operation and identify unanticipated situations that can be used to develop new or revise existing scenarios.	
73. Before the deployment of the ADS, the manufacturer should establish processes to demonstrate its capabilities to execute an effective ISMR. These processes should be documented as part of the manufacturer's SMS.	
74. The monitoring program established by the manufacturer should collect and analyse vehicle data, and data from other sources. The data analysis should be performed with sufficient frequency so that remedial action can be taken promptly and in line with reporting requirements.	
75. The reporting applies to occurrences (i.e. critical occurrence and non-critical occurrence) and safety relevant events (e.g. fallback user unavailability), which are relevant to the safety performance of ADS. The reporting, including initial notifications, short-term reports and periodic reports, will be carried out according to the requirements by the relevant authority.	
76. This UN GTR requires the manufacturer to establish the processes for ISMR in order to contribute to the improvement of road safety by ensuring that relevant information on safety is collected, processed, and disseminated.	
8. Rationale for Virtual testing credibility assessment	

UN GTR	UN Regulation
77. High confidence in simulation toolchain credibility is needed so that virtual testing can be used by the manufacturer to validate the safety of their ADS on its own and in conjunction with the other testing pillars. This requires that each simulation toolchain provide an accurate representation of the real-world system where the ADS operates. Therefore, it is essential to set up a harmonized credibility framework as part of this UN GTR. The framework includes simulation toolchain management, simulation toolchain requirements, simulation toolchain verification and simulation toolchain validation.	
9. Rationale for audit of SMS	
78. The purpose of the SMS audit pillar is to allow the relevant authority to determine that the manufacturer has established robust processes to manage safety risks, manage safety throughout the ADS lifecycle, and that the manufacturer is compliant with the requirements as outlined in this UN GTR.	
79. Given that the ISMR is also included in the SMS, the audit of the SMS should review the manufacturer's documentation to ensure the suitability of ISMR practices (processes, tools, personnel) for the ADS and evaluate the manufacturer's capability to monitor the ADS and to report any occurrences/safety relevant events during the ADS operation. Documentation should also note the manufacturer's approach/methods to verify the safety performance of the ADS and for reporting the occurrences/safety relevant events experienced by the ADS during the operation.	
80. This UN GTR specifies the requirements for the audit of SMS, including audit of the manufacturer's ISMR mechanism.	

UN GTR	UN Regulation
10. Rationale for testing	
81. The manufacturer should demonstrate that the approach to testing (virtual testing, track testing, real-world testing) and the scenario coverage/selection are suitable to validate/verify the safety case and compliance with the associated performance/functional requirements specified in this UN GTR.	
82. Regarding from the assessment aspect, there are two main parts outlined in this UN GTR. One component is for assessment of the safety case testing activities and the other is for confirmatory testing.	
F. Existing regulations, directives, and international voluntary standards	
[List of standards to be placed in Guidance document] [83. The purpose of compiling this list of existing regulations and standards is to provide a comprehensive overview of the current landscape governing automated driving systems. The list categorizes these into three main sections: (a) UN guidance used as a basis for the development of the GTR/UNR; (b) Standards and regulations referenced in the GTR/UNR; (c) Other standards and regulations identified. This compilation aims to facilitate better understanding, comparison, and alignment of ADS regulatory practices globally, reflecting the foundational work accomplished by the groups from UN and highlighting the current regulatory status of contracting parties.]	
[List of standards to be placed in Guidance document]	

UN GTR	UN Regulation
G. Benefits and costs	
84. For the time being, ADS will not be mandatory for vehicles. Currently there is only one specific ADS application for which ADS regulation has been developed (ALKS/R157). Consequently, for all other ADS applications except ALKS, there is no clear regulation which helps manufacturers in developing their ADS and authorities in validating the related products and processes. This GTR is an important prerequisite to support the process of harmonization of engineering and validation requirements.	
85. For ADS technology, the issue of responsibility attribution is one of the core challenges on its development path. Based on the authoritative platform of WP.29, formulating a comprehensive set of global technical regulations for ADS with international consensus is an important step in improving the relevant legal environment, while also clarifying the current capabilities and limitations of ADS technology. In this way, provisions can be built upon the existing technological conditions through a regulation that establishes a clear and reasonable framework for responsibility attribution. ==This framework establishes traceable technical parameters and system behavior logging requirements for manufacturers and software developers.== In accident scenarios, the documented technical evidence provides an auditable basis for accountability determination processes, while maintaining adaptability for evolving ADS verification methodologies. The standardized technical benchmarks support alignment with legal proceedings without constituting legal judgments.	

UN GTR	UN Regulation
86. Social trust and acceptance are key to the widespread integration of ADS technology into people's daily lives. The formulation and subsequent use of ADS regulations can play a important role in enhancing public awareness, dispelling misunderstandings, and fostering trust. These processes not only provide the public with a more comprehensive and in-depth understanding of ADS technology but also, through legal commitments and safeguards, might alleviate people's uncertainties and fears about the new technology. In the long run, this could create a positive and open social environment for realizing the grand vision of intelligent transport.	
87. At this stage of ADS development, there is no quantitative data to support a thorough cost-benefit analysis. With the accumulation of data from various deployments and testing, the GTR might help quantifying both the costs and benefits of ADS regulation. A globally harmonized regulation may potentially reduce costs and increase efficiencies for manufacturers. Such benefits may stem from streamlined production processes as well as the resources required to adapt to different regulatory regimes. For example, manufacturers may not be required to retool production facilities to comply with different regulations in different countries. With wider application of ADS, more data will become available to improve the cost/benefit analysis.	

UN GTR	UN Regulation
88. Empirical data from ADS demonstration zones and research institutions worldwide highlight the potential benefits and challenges of ADS technology across diverse traffic environments. Statistical analyses of passenger vehicles indicate that accident rates in ADS modes are consistently lower than in manual driving. A joint study spanning North America, Europe, and Asia found an average of 18.5 accidents per million kilometres in manual driving (10.2 at-fault accidents), compared to 7.1 accidents in automated driving (2.8 at-fault accidents). Notably, some leading technology providers have achieved zero at-fault accidents per million kilometres in automated mode.	
84. However, challenges to traffic efficiency persist, particularly during peak hours or in complex scenarios. Studies suggest automated vehicles may experience a 5%-15% reduction in average speed compared to human drivers, primarily due to conservative following distance decisions, suboptimal route planning, and delayed responses to dynamic environments. For example, pilot projects in multiple urban areas reported peak-hour automated vehicle speeds of 22–28 km/h, 10%-18% lower than manual driving, with travel times increasing by 8%-12% on average.	

UN GTR	UN Regulation
85. This regulation's development, while resource-intensive, promises safety improvements. The GTR could prevent an estimated 250,000 global fatalities and reduce severe injuries through comprehensive implementation of automated driving systems (ADS). The collaborative process has enhanced knowledge-sharing between automakers, governments, and research bodies, creating transferable insights for future regulatory work—including ADAS standards. Notably, this marks the first simultaneous development of a GTR and corresponding UN Regulation (UNR) for shared safety goals, setting a new benchmark for international regulatory cooperation. Key technical elements from this GTR also demonstrate broader applicability, potentially informing updates to existing driver assistance regulations. The established framework may accelerate future rulemaking processes in evolving automotive technologies.	
86. At the same time, qualitative analysis remains equally important. Factors such as user acceptance, public perception, and regulatory adaptability cannot be fully captured through numbers alone. A deeper examination is required to ensure comprehensive regulation. By combining both quantitative and qualitative analyses, decision-making for future regulation development can be optimized. This regulation provides important sources for these analyses, such as In Service Monitoring and Reporting (ISMR). This ISMR element helps to balance supporting innovation with controlling the safety level. Output of ISMR can be used to further improve ADS regulation where needed.	
II. Text of the Regulation	
	0. Introduction

UN GTR		UN Regulation	
1.	Purpose		
1.1.	This Global Technical Regulation (GTR) provides worldwide harmonised procedures to set and verify compliance with minimum requirements for the safety of Automated Driving Systems (ADS) and vehicles equipped with ADS.	1.1. This Regulation establishes uniform provisions concerning the approval of motor vehicles with regard to their Automated Driving Systems (ADS). [Placeholder for revised introductory text which will be provided by the Workshop]	
2.	Scope	1.	Scope
2.1.	This GTR applies to the Automated Driving Systems of vehicles of categories 1 and 2.	1.1.	This Regulation applies to the approval of vehicles of categories M, N, L6, and L7 with regard to their Automated Driving Systems.
		1.2.	This Regulation does not apply to vehicles with regard to any ADS feature that has been approved pursuant to UN Regulation No. 157 as an Automated Lane Keeping System (ALKS), except with regard to the integration of the ALKS with the ADS and any interaction of the ALKS with other ADS features.
3.	Definitions	3	Definitions
3.1.	*"Automated Driving System (ADS)"* means the vehicle hardware and software that are collectively capable of performing the entire Dynamic Driving Task (DDT) on a sustained basis.[31]		
3.2.	*"ADS vehicle"* means a vehicle equipped with an ADS.		
3.3.	*"Dynamic Driving Task (DDT)"* means the real-time operational and tactical functions required to operate the vehicle.		
3.3.1.	When the ADS feature is active, the DDT is always performed in its entirety by the ADS which means the whole of the tactical and operational functions necessary to operate the vehicle (i.e., the ADS performs "the entire DDT" as stated in the definition of an "Automated Driving System" under para. 3.3.). These functions can be grouped into three interdependent categories: sensing and perception, planning and decision, and control.		
3.3.2.	Sensing and perception include:		
	(a) Monitoring the driving environment via object and event detection, recognition, and classification,		

---

[31] This definition is based on SAE J3016 and ISO/PAS 22736 (Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles). These standards define levels of driving automation based on the functionality of the driving automation system feature as determined by an allocation of roles in DDT and DDT fallback performance between that feature and the (human) user (if any). The term "Automated Driving System" is used specifically to describe a Level 3, 4, or 5 driving automation system.

UN GTR	UN Regulation
(b) Perceiving other vehicles and road users, the roadway and its fixtures, objects in the vehicle's driving environment and relevant environmental conditions,	
(c) Sensing the ODD boundaries, if any, of the ADS feature, and	
(d) Positional awareness.	
3.3.3. Planning and decision include:	
(a) Predicting actions of other road users,	
(b) Response preparation, and	
(c) Manoeuvre planning.	
3.3.4. Control includes:	
(a) Object and event response execution,	
(b) Lateral vehicle motion control,	
(c) Longitudinal vehicle motion control, and	
(d) Enhancing conspicuity via lighting and signalling.	
3.3.5. The DDT excludes strategic functions.	
3.4. *"Real time"* means the actual time during which a process or event occurs.	
3.5. *"(ADS) function"* means an ADS hardware and software capability designed to perform a specific portion of the DDT.	
3.5.1. *"Operational function"* means a capability to control the real-time motion of the vehicle.[32]	
3.5.2. *"Tactical function"* means a capability to perceive the vehicle environment and control real-time planning, decision, and execution of manoeuvres, including conspicuity of the vehicle and its motion.[33]	
3.5.3. *"Strategic function"* means a capability to issue commands, instructions, or guidance for execution by an ADS.[34]	
3.6. *"(ADS) feature"* means an application of an ADS designed specifically for use within an Operational Design Domain (ODD).	

---

[32] Operational functions involve executing micro-changes in steering, braking, and accelerating to maintain lane position or proper vehicle separation and immediate responsive actions to avoid crashes in critical driving situations.

[33] Examples include deciding whether to overtake a vehicle or change lanes, signalling intended manoeuvres, deciding when to initiate the manoeuvre, choosing the proper speed, and executing the manoeuvre.

[34] Examples include setting the starting point, destination, route, and way points to be used by an ADS during a trip.

UN GTR	UN Regulation
3.6.1.	*"ADS feature of type 1 (ADSF-1)"* means an ADS feature which includes an ADS fallback response requiring a fallback user.
3.6.2.	*"ADS feature of type 2 (ADSF-2)"* means an ADS feature which does not include an ADS fallback response requiring a fallback user.
3.7.	*"ADS Feature Active"* means an ADS Feature is performing the DDT.
3.8.	*"ADS Feature Activation"* means the act of changing the operational state of an ADS feature, from available to active
3.9.	*"ADS Feature Available"* means the operational state of an ADS feature pursuant to the ADS verification that the ODD conditions of the feature have been met and prior to activation of the feature but is not performing any part of the DDT.
3.10.	*"ADS Feature Deactivation"* means the act of changing the operational state of the ADS feature, from the state in which it is performing all of the DDT to the state in which it is performing none of the DDT. This could be a user-initiated deactivation to manual driving, a system-initiated deactivation to manual driving or the system returning to ADS Standby whilst the vehicle is stopped.
3.11.	[*"Data Storage System for Automated Driving (DSSAD)"* means a capability of a vehicle to monitor and enable evaluation of the performance of the ADS.]
3.11.1.	*"(DSSAD) triggering event"* means a time-stamped data element which triggers the recording and storing of time-series data elements.
3.11.2.	*"Emergency manoeuvre"* means a manoeuvre performed by the system in case of an event in which the vehicle is at imminent collision risk and has the purpose of avoiding or mitigating a collision.
3.11.3.	*"Imminent collision risk"* means a situation or an event which leads to a collision of the vehicle with another road user or an obstacle which cannot be avoided by a braking demand lower than 5 m/s^2.
3.11.4.	[*"Detected objects"* shall mean objects detected by the perception system of the vehicle and classified by the ADS as relevant for the purpose of performing a dynamic driving task. Objects with a negative relative velocity shall be deemed relevant.]
3.12.	*"Operational Design Domain (ODD)"* means the operating conditions under which an ADS feature is specifically designed to function.
3.12.1.	*"ODD exit"* means:
	(a) the presence of one or more ODD conditions outside the limits defined for use of the ADS feature, and/or
	(b) the absence of one or more conditions required to fulfil the ODD conditions of the ADS feature.
3.13.	*"Occurrence"* means a safety-relevant event involving an ADS vehicle.[35]
3.13.1.	*"Critical Occurrence"* means an occurrence during which at least one of the following criteria is fulfilled:

---

[35]   The occurrences to be reported are listed in the Annex [occurrence list annex].

UN GTR	UN Regulation
(a) At least one person suffers an injury that requires medical attention or dies as a result of being in the vehicle or being involved in the event,	
(b) The ADS vehicle, other vehicles, or stationary objects sustain physical damage that exceeds a certain threshold,	
(c) Any vehicle involved in the event experiences a deployment of any non-reversible occupant restraint system, vulnerable road user secondary safety system, or the delta-V thresholds to be met, whichever occurs first.	

3.13.2.	*"Significant Occurrence"* means occurrences which are not "Critical Occurrences" but require to be reported on short term basis due to their relevance on safety.	
3.13.3.	"Vulnerable road user secondary safety system" means a deployable vehicle system outside the occupant compartment designed to mitigate injury consequences to vulnerable road users during a collision.	
3.14.	*"(ADS) user"* means a human user of an ADS vehicle.	
3.14.1.	*"Occupant"* means an ADS user located inside an ADS vehicle.	
3.14.2.	*"Driver"* means an ADS user who performs in real time part or all of the DDT for a particular ADS vehicle.	
3.14.3.	*"Fallback user"* means an occupant designated to perform the DDT pursuant to an ADS fallback response.	
3.14.4.	*"(ADS) Passenger"* means an occupant who is not a driver or fallback user.	
3.15.	*"ADS fallback response"* means a system-initiated deactivation procedure or an ADS-controlled procedure to place the vehicle in a mitigated risk condition (MRC).	
3.16.	*"System-initiated deactivation of the ADS"* means a procedure by which the ADS initiates the transfer of performance of the DDT from an ADSF-1 to a fallback user.	
3.17.	*"User-initiated deactivation of the ADS"* means a procedure by which the user initiates the transfer of performance of the DDT from an ADS feature to the user.[36]	
3.18.	*"Suppressed",* in relation to manual controls, means a condition, in which a control function is limited or has limited effect until a threshold is exceeded.	
3.19.	*"Remote termination"* means the act of remotely disabling one or more ADS features of one or more vehicles.	
3.20.	*"Mitigated Risk Condition (MRC)"* means a stable and stopped state of the vehicle that reduces the risk of a crash.	
3.21.	*"Other road user (ORU)"* means any entity making use of publicly accessible road infrastructure.	

---

[36] Where an ADSF-2 suggests that a user might optionally take control, this shall be considered a user-initiated deactivation if the user accepts the suggestion.

UN GTR		UN Regulation
3.21.1.	*"Road-safety agent"* means a human engaged in directing traffic, enforcing traffic laws, and/or responding to traffic incidents.	
3.21.2.	*"Priority vehicle"* means a vehicle subject to exemptions, authorizations, and/or right-of-way under traffic laws while performing a specified function	
3.22.	*"Behavioural competency"* means an expected and verifiable capability of an ADS feature to operate a vehicle within the ODD of the feature.	
3.23.	*"Failure"* means the termination of an intended behaviour of a system or component due to fault manifestation.	
3.24.	*"Fault"* means an abnormal condition that can cause a system or component to fail.	
3.25.	*"Functional safety"* means the absence of unreasonable risks under the occurrence of hazards caused by a malfunctioning behaviour of electric/electronic systems (safety hazards resulting from system faults).	
3.26.	*"Safety of the intended functionality (SOTIF)"* means the absence of unreasonable risk due to hazards resulting from functional insufficiencies of the intended functionality or reasonably foreseeable misuse.	
3.27.	*"Safety Management System (SMS)"* means a systematic approach to managing safety that encompasses and integrates organisational, human, and technical factors.	
	(a) Human component ensuring the ADS lifecycle is monitored by personnel with appropriate skills, training, and understanding to identify risks and appropriate mitigation measures to identify risks and appropriate mitigation measures while accounting for the possibility of human errors.	
	(b) Organisational component procedures and methods that help to manage the identified risks, understand their relationships and interactions with other risks and mitigation measures, and help to ensure that there are no unforeseen consequences.	
	(c) Technical component using appropriate tools and equipment.	
3.28.	*"Test method"* means a structured approach to consistently derive knowledge about the performance of an ADS by means of executing tests.	
3.29.	*"Virtual testing"* means a type of testing that uses a simulation toolchain(s) to generate evidence for the manufacturer's safety case.	
3.29.1.	*"Simulation"* means the imitation of the operation of a real-world process or system over time utilizing a software implementation for some (or all) of the models, tools or test environment.	
3.29.2.	*"Simulation toolchain"* means a simulation tool or a combination of simulation tools that are used to generate evidence for the manufacturer's safety case.	
3.29.3.	*"Model"* means a description or representation of a system, entity, phenomenon, or process.	
3.29.4.	*"(Model) parameter"* means a numerical value inferred from real-world data and used to represent a system characteristic.	
3.29.5.	*"Stochastic model"* means a model involving or containing a random variable or variables pertaining to chance or probability.	

UN GTR	UN Regulation
3.29.6. *"Validation (of a simulation model)"* means the process of determining the degree to which a simulation model is an accurate representation of the real world from the perspective of its intended uses.	
3.29.7. *"Verification (of a simulation model)"* means the process of determining the extent to which a simulation model or a virtual testing tool is compliant with its requirements and specifications as detailed in its conceptual models, mathematical models, or other constructs.	
3.29.8. *"Sensor Stimulation"* means a technique whereby artificially generated signals are provided to trigger the element under testing in order to produce the result required for evaluation of the element.	
3.30. *"Proving ground"* and *"Test track"* mean a facility closed to public traffic and designed to enable physical assessment of an ADS and/or ADS vehicle performance, e.g., via sensor stimulation and/or the use of dummy devices.	
3.31. *"Edge Case"* means a low-probability occurrence that might arise within the ODD of an ADS and that warrants specific design attention due to the potential severity of outcomes that might result from encountering such a situation or condition.	
3.32. *"Safety case"* means structured documentation that provides a compelling, comprehensible, and valid case that the ADS meets the relevant ADS requirements of this regulation and is free from unreasonable risks to the ADS vehicle user(s) and other road users.	
3.32.1. *"Argument"* means a written explanation within a safety case that captures the logical connections between a claim and the evidence for achievement of that claim.	
3.32.2. *" Claim"* means a verifiable statement within a safety case.	
3.32.3. *"Evidence"* means material pertinent to demonstrating the validity of a claim such as physical test results, simulation results, analyses with supporting data, etc.	
3.33. *"Safety concept"* means a description of the measures designed into the ADS so that it operates in such a way that it is free of unreasonable safety risks to the ADS vehicle user(s) and other road users in every operating condition relevant to the ODD.	
3.34. "(Driving) situation" means the conditions surrounding a vehicle (including other road users).	
3.34.1. "Nominal situation" means a driving situation that is neither a critical nor failure situation.	
3.34.2. "Critical situation" means a driving situation that requires prompt action by the ADS to avoid or mitigate the risk of a crash that could result in adverse consequences on human health or property damage.	
3.34.3. "Failure situation" means a driving situation where a failure compromises the capability of the ADS to perform the entire DDT	
3.35. "Traffic scenario" means a representation of a sequence of driving situations that can occur during a given trip.	
3.35.1. "Nominal scenario" means a traffic scenario representing one or more nominal driving situations	
3.35.2. "Critical scenario" means a traffic scenario representing one or more critical situations.	

UN GTR	UN Regulation
3.35.3. "Failure scenario" means a means a traffic scenario representing one or more failure situations.	
3.35.4. *"Functional scenario"* means a basic traffic scenario describing a situation and its corresponding elements at the highest level of abstraction in natural, non-technical language.[37]	
3.35.5. *"Logical scenario"* means a traffic scenario elaborated at a lower level of abstraction to include value ranges or probability distributions for each element of the corresponding functional scenario.[38]	
3.35.6. *"Concrete scenario"* means a traffic scenario at a level of abstraction in which specific values have been selected for each element from the continuous ranges as may be defined in the corresponding logical scenario.	
3.36. *"Post-production phase"* means the period in which an ADS vehicle is no longer produced until the end-of-life of all ADS vehicles of the same type. The phase ends when there are no longer any operational ADS vehicles of a specific ADS type.	
3.37. *"Useful life (of an ADS vehicle)"* means the duration during which an ADS vehicle is in an operational state under which it may be driven on public roads regardless of the operational state of the ADS.	
3.38. *"Safety relevant objects"* means an object which if collided with is likely to cause non-trivial damage to the vehicle or that is likely to pose a safety risk to other road users, vehicle occupants or infrastructure.	
	[3.39 "Vehicle Type with regard to its Automated Driving System (ADS)" means a category of vehicles which do not differ in such essential aspects as: (a) The system characteristics and design of the ADS; (b) Vehicle features which significantly influence the performance of the ADS.]
	3. Application for Approval
	3.1. The application for approval of a vehicle type with regard to the ADS shall be submitted by the ~~[vehicle]~~ manufacturer or by their duly accredited representative.
	3.2. It shall be accompanied by the documents mentioned below in triplicate:
	3.2.1. A certificate of compliance for the SMS in accordance with this regulation.
	3.2.2. A description of the vehicle type with regard to the items mentioned in paragraph [XXX], together with a documentation package as required in Annex [X] which gives access to the basic design of the ADS and the means by which it is linked to other vehicle systems or by which it directly controls output variables. The numbers and/or symbols identifying the vehicle type shall be specified.

[37] For example, a description of the ego vehicle's actions, the interactions of the ego vehicle with other road users and objects, and other elements that compose the scenario such as environmental conditions.

[38] For example, elaborating the lane element to cover possible lane widths.

UN GTR	UN Regulation	
	3.3.	In cases where information is shown to be covered by intellectual property rights or to constitute specific know-how of the manufacturer or of their suppliers, the manufacturer or their suppliers shall make available sufficient information to enable the checks referred to in this Regulation to be made properly. Such information shall be treated on a confidential basis.
	3.4.	Certificate of Compliance for a Safety Management System according to paragraph [x] of this Regulation (hereinafter referred to as "Certificate of Compliance for SMS").
	3.4.1.	Each Contracting Party issuing type approvals pursuant to this Regulation shall appoint an Approval Authority to carry out the assessment of the manufacturer and to issue a Certificate of Compliance for the SMS.
	3.4.2.	An application for a Certificate of Compliance for SMS shall be submitted by the manufacturer or by their duly accredited representative.
	3.4.3.	It shall be accompanied by the undermentioned documents in triplicate, and by the following in particular: [XXX]. Documents describing the Safety Management System.
	3.4.4.	A signed declaration using the model as defined in Appendix [X] to Annex [XXX].
	3.4.5.	In the context of the assessment, the manufacturer shall declare using the model as defined in Appendix [X] to Annex [X] and demonstrate to the satisfaction of the Approval Authority or its designated technical service that they have the necessary processes to comply with all the requirements for the SMS according to this Regulation.
	3.4.6.	When this assessment has been satisfactorily completed and in receipt of a signed declaration from the manufacturer according to the model as defined in Appendix [X] to Annex [X], a certificate named "Certificate of Compliance for a Safety Management System as described in Annex [X] to UN Regulation No. [xXX]" shall be granted to the manufacturer.
	3.4.7.	The Approval Authority or its designated technical service shall use the model set out in Annex [X] to this Regulation for the Certificate of Compliance for SMS.

UN GTR	UN Regulation
	[3.4.8. [XX The initial Certificate of Compliance for SMS issued by the Approval Authority will have a validity of maximum 3 years. The Approval authority shall perform a re-assessment within one year after granting the first ADS approval under this the certificate of compliance.]]
	3.4.9. The Approval Authority which has granted the Certificate of Compliance for SMS may at any time verify that the requirements for it continue to be met. The Approval Authority shall withdraw the Certificate of Compliance for SMS if the requirements laid down in this Regulation are no longer met.
	3.4.10. The manufacturer shall inform the Approval Authority or its designated technical service of any change that will affect the relevance or validity of the Certificate of Compliance for SMS. After consultation with the manufacturer, the Approval Authority or its designated technical service shall decide whether a new assessment is necessary.
	3.4.11. In due time, permitting the Approval Authority to complete its assessment before the end of the period of validity of the Certificate of Compliance for SMS, the manufacturer shall apply for a new (or for the extension of the existing) Certificate of Compliance for SMS. The Approval Authority shall, subject to a positive outcome of the assessment assessment, issue a new Certificate of Compliance or an extension of the existing Certificate of Compliance with a validity for a further period of maximum three years. The Approval Authority shall verify that the SMS continues to comply with the requirements of this Regulation. The Approval Authority shall issue a new certificate (or extend the existing certificate) in cases where changes have been brought to the attention of the Approval Authority or its designated technical service and assessment of the changes result in a positive judgement.
	3.4.12. The expiry or withdrawal of the manufacturer's Certificate of Compliance for SMS shall be considered, with regard to the vehicle types to which the SMS concerned was relevant, as modification of approval, as referred to in this regulation, which may include the withdrawal of the approval if the conditions for granting the approval are no longer met.
	3.5. A vehicle representative of the vehicle type to be approved shall be submitted to the designated technical service responsible for conducting approval tests.
	3.6. Documentation shall be made available in two parts:

UN GTR	UN Regulation
	(a) The formal documentation package for the approval, containing the material specified in Annex [x] which shall be supplied to the Approval Authority or its designated technical service at the time of submission of the type approval application. This documentation package shall be used by the Approval Authority or its designated technical service as the basic reference for the approval process. The Approval Authority or its designated technical service shall ensure that this documentation package remains available for at least [10] years counted from the time when production of the vehicle type is definitely discontinued.
	(b) Additional material relevant to the requirements of this regulation may be retained by the manufacturer but shall be open for inspection at the time of type approval. The manufacturer shall ensure that any material made open for inspection at the time of type approval remains available for at least a period of 10 years counted from the time when production of the vehicle type is definitely discontinued.
	4. Approval
	4.1. Approval Authorities shall grant, as appropriate, type approval with regard to Automated Driving Systems, only to such vehicle types that satisfy the requirements of this Regulation.
	4.1.1. The Approval Authority or the designated technical service shall verify by means of document checks and appropriate testing that the manufacturer has taken the necessary measures relevant for the vehicle type to: [Placeholder – list of fundamental aspects that the manufacturer must demonstrate to the TAA and TS; to come from the work of the 'Assessment' OPI.]
	4.1.2. The Approval Authority or the designated technical service shall verify by testing of a vehicle of the vehicle type that the manufacturer has implemented the measures they have documented. Tests shall be performed by the Approval Authority or the designated technical service itself, or in collaboration with the manufacturer, by sampling.
	4.1.2.1 [Testing shall at least include track and real world testing]

UN GTR	UN Regulation	
	4.1.2.2	[Track testing may be omitted if the Approval Authority or the designated technical service deems the evidence collected by real world testing sufficient to verify that the manufacturer has implemented the measures they have documented.]
	4.1.3.	The Approval Authority or designated technical service shall refuse to grant the type approval where the manufacturer has not fulfilled one or more of the requirements of this regulation.
	4.1.4	The assessing Approval Authority shall also refuse to grant the type approval where the Approval Authority or designated technical service has not received sufficient information from the manufacturer to assess the Automated Driving System of the vehicle type.
	4.2.	Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the 1958 Agreement which apply this Regulation, by means of a form conforming to the model in Annex [X] to this Regulation.
	4.3.	Approval Authorities shall not grant any type approval without verifying that the manufacturer has put in place satisfactory arrangements and procedures to properly manage all aspects required by this Regulation.
	4.3.1.	The Approval Authority and its designated technical services shall ensure, in addition to the criteria laid down in Schedule 2 of the 1958 Agreement that they have:
		(a) Competent personnel with appropriate skills and specific knowledge of functional safety, safety of the intended functionality, modelling & simulation, and human factors.
		(b) Implemented procedures for the uniform evaluation according to this Regulation.
	4.4.	For the purpose of paragraph [SMS] of this Regulation, the manufacturer shall ensure that the safety management aspects covered by this Regulation are implemented.
	[4.5.	Approvals covering ADS features which can be activated in the territory of other Contracting Parties]

UN GTR	UN Regulation
	4.5.1. Before granting an approval according to this UN Regulation, the granting Approval Authority shall contact the Approval Authorities of the respective Contracting Parties in whose territory any feature of the Automated Driving System can be activated, in accordance with Paragraph 1 of Schedule 6 to the 1958 Agreement. The following information shall be provided as a minimum:
	(a) … (b) … *
	[Notwithstanding the period specified in Schedule 6 to the 1958 Agreement, a period of [x days] shall be allowed for replies from the other approval authorities.]
	4.5.2. Following the review in accordance with paragraph 4.5.1, in accordance with Article 10 of the 1958 Agreement, the receiving Approval Authority may give notice to the granting Approval Authority using the model given in Appendix [x] that the Contracting Party concerned disagrees with the interpretation or application of this UN Regulation *.
	4.5.2.1. [In this case, the granting Approval Authority shall ensure that the territory of the Contracting Party concerned is excluded from the ODD of the ADS feature(s) concerned and shall not include that Contracting Party in Appendix [x] to Annex 1.]
	4.5.2.2. [If the requirements of paragraph 4.5.2.1. are not fulfilled, in accordance with Article 4 of the 1958 Agreement, the Contracting Party concerned may prohibit the sale and use of such wheeled vehicles in their territory until the dispute is resolved and shall inform the secretariat of the Administrative Committee of this situation.]
	4.5.3. [In the case that the granting Approval Authority disagrees with the reasons given by the receiving Approval Authority in the notification according to paragraph 4.5.2, this dispute shall be settled in accordance with Article 10 and Schedule 6 of the 1958 Agreement. The Contracting Parties shall also inform the relevant subsidiary Working Party of the World Forum for Harmonization of Vehicle Regulations (WP.29) of the diverging interpretations within the meaning of Schedule 6 to the 1958 Agreement. The relevant subsidiary Working Party shall support the settlement of the diverging views and may consult with WP.29 on this if needed.]

UN GTR	UN Regulation
	4.5.4. [In the case that the territory of an additional Contracting Party is added as part of the extension of a type approval, the requirements of paragraphs 4.5.1 to 4.5.3 shall apply *mutatis mutandis* with respect to that Contracting Party and its Approval Authority.]
	4.5.5. [In the case of modifications to a vehicle type resulting in extension of an approval which covers territory of other Contracting Parties, the granting Approval Authority shall consider whether these changes constitute new significant interpretations. If so, the Approval Authorities of the relevant Contracting Parties shall be consulted in accordance with Paragraph 1 of Schedule 6 to the 1958 Agreement. In the case of any dispute, the provisions of paragraphs 4.5.2 and 4.5.3 shall apply.]
	4.5.6. [Each Approval Authority shall, within 14 days after granting or extending a type approval pursuant to this Regulation, upload the type approval together with the supplementing documentation (including all related test reports) in English language to the secure internet database "DETA", established by the United Nations Economic Commission for Europe.]
	4.6. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:
	4.6.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval(footnote),
	4.6.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.6.1. above, and
	4.6.3. An additional symbol consisting of the roman numerals for the type(s) of ADS feature present in the ADS which has been approved.
	4.7. If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.6.1. above need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.6.1. above.
	4.8. The approval mark shall be clearly legible and be indelible.

UN GTR	UN Regulation
	4.9. The approval mark shall be placed close to or on the vehicle or bodywork data plate affixed by the manufacturer.
	4.10. Annex [2] to this Regulation gives examples of arrangements of approval marks.
4. General requirements	
4.1 This Regulation establishes:	
(a) Performance requirements for ADS and ADS vehicles,	
(b) Requirements for manufacturer design, development, validation, and monitoring of ADS and ADS vehicles, and	
(c) Assessment procedures and criteria to verify compliance with the above requirements	
4.2. The Regulation aims to ensure that ADS vehicles will be safe for use on public roads.	
4.2.1. As a general concept, the safety level of ADS shall be at least to the level of a competent and careful human driver.	
4.3. ADS requirements	
4.3.1. This Regulation contains provisions concerning: (a) ADS performance of the Dynamic Driving Task (paragraph 5.1.), (b) The safety of interactions between ADS and their users (paragraph 5.2.), and (c) For data-recording systems, cyber security, software management, and other areas relevant to the safe deployment of ADS on public roads (para. 5.3.).	
4.3.2. The DDT performance requirements establish a framework for the evaluation of the ADS capabilities: (a) Under nominal situations (b) Under critical situations (c) Under failure situations (d) At Operational Design Domain (ODD) boundaries (e) In fallbacks to a Mitigated Risk Condition (MRC).	
4.3.2.1. The requirements under nominal [situations] concern the functional capabilities of the ADS to perform the entire DDT necessary to operate the vehicle within the ODD of its features.	
4.3.2.2. The requirements under critical [situations] concern the behavioural capabilities of the ADS to mitigate the risks and consequences of conflicts with other road users	

UN GTR	UN Regulation
4.3.2.2.1. The requirements for DDT performance under nominal [situations] continue to apply under critical [situations] as far as is reasonably practicable given the specific circumstances.	
4.3.2.3. The requirements under failure [situations] concern the capabilities of the ADS to detect and manage failures that compromise its ability to perform the DDT.	
4.3.2.4. The requirements for DDT performance at ODD boundaries concern [the ADS capabilities to detect and respond to ODD boundaries and ODD exit]	
4.3.2.5. The requirements for performance of fallbacks to a Mitigated Risk Condition concern the ADS capabilities to bring the vehicle to a safe stop.	
4.3.3. Safety of interactions between ADS and their user(s)	
4.3.4. Other requirements relevant to safe deployment of ADS on public roads 4.3.4.1. Data Storage Systems for Automated Driving 4.3.4.1.1. The Regulation includes requirements for Data Storage System for Automated Driving (DSSAD), which refers to the data storage capability of a vehicle to monitor the safety performance of ADS. This system contributes to the evaluation of ADS performance and supports the identification of safety-relevant behavior during vehicle operation	
4.3.4.2. [Cyber security management] 4.3.4.3. [Software updates management]	
4.4. Manufacturer requirements 4.4.1. This Regulation establishes requirements for:	
(a) The Safety Management System of the manufacturer	
(b) The testing environments used by the manufacturer to generate evidence to support the ADS safety case,	
(c) The techincal documentation of the ADS safety concept and the claims, arguments, and evidence used to validate the concept,	
(d) The requisite capabilities for monitoring and reporting on ADS post-deployment safety performance.	
4.4.2. Safety Management System	
4.4.2.1. This Regulation requires the manufacturer to document its processes for ensuring that the ADS is free of unreasonable safety risks.	
4.4.2.2. The Regulation establishes requirements for managing safety throughout the useful life of the ADS vehicle, including the following stages:	

UN GTR	UN Regulation
(a) Development, (b) Production, (c) Operation, and (d) Decommissioning.	
4.4.2.3. The Regulation requires these processes, collectively known as the Safety Management System (SMS), to address safety risks associated with organisational, human, and technical factors.[39]	
(a) Organisational factors concern procedures and methods to manage identified risks, understand their relationships and interactions with other risks and mitigation measures, and reduce the risk of unforeseen consequences.[40]	
(b) Human factors concern the roles of personnel, their skills, training, and understanding to identify risks and mitigation measures, and processes to control for the possibility of human error. [41]	
(c) Technical factors concern the tools and equipment used to identify risks and evaluate mitigation measures.[42]	
4.4.2.4. The Regulation requires the manufacturer's documentation to cover the following aspects:[43]	
(a) Safety policy (paragraph 6.1.2.) (b) Risk management (paragraph 6.1.3.) (c) Safety assurance (paragraph 6.1.4.) (d) Safety promotion (paragraph 6.1.5.) (e) Management of Design and development (paragraph 6.1.6.) (f) Management of Production (paragraph 6.1.7.) (g) Management of Post-deployment (paragraph 6.1.8.)	
4.4.3. Test environments	

---

[39] Based on ADS-05-13: "The SMS shall manage and improve safety by considering organizational, human and technical risk factors."

[40] ADS-05-13: "Organisational component procedures and methods that help to manage the identified risks, understand their relationships and interactions with other risks and mitigation measures, and help to ensure that there are no unforeseen consequences"

[41] ADS-05-13: "Human component ensuring the ADS lifecycle is monitored by personnel with appropriate skills, training, and understanding to identify risks and appropriate mitigation measures while accounting for the possibility of human errors"

[42] ADS-05-13: "Technical component using appropriate tools and equipment."

[43] These are the section headings in ADS-05-13. The word "process" has been dropped as unnecessary (and possibly misleading since these management aspects can involve many processes, not just one). Cross-references are added to guide the reader to the corresponding sections.

UN GTR	UN Regulation
4.4.3.1. The manufacturer shall demonstrate the suitability of the testing environments used in the demonstration of the safety case and the compliance with performance/functional requirements.	
4.4.3.1.1. The manufacturer shall demonstrate that the simulation toolchain(s) is suitable for conducting virtual tests. The requirements for the simulation toolchain(s) are listed in 6.2.1.	
4.4.3.1.2. The manufacturer shall demonstrate that the track testing facilities (proving ground) and environment are suitable for the tests that are being conducted in line with the requirements listed in 6.2.2.	
4.4.3.1.3. The manufacturer shall demonstrate that the real-world testing facilities and environment are suitable for the tests that are being conducted in line with the requirements listed in 6.2.3.	
4.4.4. Safety case 4.4.4.1. The Regulation requires the manufacturer to produce a safety case for the ADS and its feature(s) in a manner that demonstrates the application of the SMS to the ADS under assessment, including the following aspects: (a) The safety concept, which describes the hazard identification and mitigation measures designed into the ADS to meet the requirements of this regulation and achieve the goal of avoidance of unreasonable risk with regard to SOTIF and functional safety, (b) Information and documentation necessary to describe the ADS covered by the safety case, including the intended use, the operating environment, the interactions with humans, sub-systems and components, control strategies, (c) Structured claims, argumentation, and evidence (including validation tests) that affirm and demonstrate that the ADS meets the requirements in Section 5 and is free from unreasonable risks to the ADS vehicle user(s) and other road users,	
(d) Demonstration of credibility and suitability of test tools used in generating evidence, and	
(e) Explanation of the processes for reinforcing ADS safety throughout the life of the ADS.	
4.4.5. Post-deployment safety	
4.4.5.1. The Regulation requires manufacturers to perform in-service monitoring and reporting (ISMR) on the safety performance of their ADS in use.	
4.4.5.1.1 The In-Service Monitoring and Reporting (ISMR) of the manufacturer shall ensure the ADS's safety throughout the lifetime of the ADS	
4.4.5.2. The Regulation requires the manufacturer to put in place an In-Service Monitoring mechanism to collect information from the ADS vehicles in accordance with the requirements listed in under paragraph 6.1.8.:	
(a) To confirm the safety case and confirm the validation carried out by the manufacturer before market introduction,	(a) To confirm the safety case and confirm the validation carried out by the manufacturer before the granting of the approval.
(b) To enable the identification of unreasonable risks related to the use of an ADS on public roads and the evaluation of its safety performance during real-world operation,	

UN GTR		UN Regulation
(c)	To enable the identification of unanticipated situations, hazards, and risks that lead to unexpected behaviour of the ADS. This information shall be assessed by the manufacturer and where appropriate be used to develop new or revise existing scenarios derived from ISMR activities.	
4.4.5.3.	The Regulation requires the manufacturer to have mechanisms for receiving and analysing safety-relevant feedback and reports from other sources, in accordance with the requirements listed in 6.1.8, to complement the data collected from ADS vehicles.	
4.4.5.4.	The manufacturer shall put in place a reporting mechanism in accordance with the requirement listed in the 6.4: (a)To collect, analyze the safety-relevant information related to its in-service ADS' operation thatidentifies situations which fall into the cases specified for short term and periodic reporting. (b)To allow information from the ISMR and recommendations from its analysis to be shared with therelevant authority	
4.4.5.5.	ISMR reports indicating that the ADS poses an unreasonable safety risk will trigger actions to address non-conformities in accordance with the applicable law.	
4.4.5.6.	These requirements are without prejudice to applicable laws governing: (a) Access to data, (b) Availability of data, (c) Data privacy, (d) Data protection, and (e) Provision of data to other authorities.	
4.6. 4.6.1. 4.6.2. 4.6.3. 4.6.4.	Compliance assessments Audit of the Safety Management System ADS Testing Credibility Assessments Assessment of the Safety Case for the ADS Post-deployment Safety	
5.	ADS Requirements	
5.1.	Performance of the DDT	
5.1.1.	The ADS shall be capable of performing the entire DDT within the ODD of its feature(s).	
5.1.2.	ADS Performance of the DDT in Nominal Traffic Situations	

UN GTR	UN Regulation
5.1.2.1. The driving behaviour of the ADS shall not cause a collision.[44]	
5.1.2.2. The ADS shall adapt its driving behaviour in line with safety risks, this shall at least include: (a) anticipating the risks in the driving environment to reduce the likelihood of encountering a critical situations. (b) adapting its speed in line with safety risks. (c) maintaining appropriate distances from other road users by controlling the longitudinal and lateral motion of the vehicle.	
5.1.2.3. The ADS shall avoid unreasonable disruption to the flow of traffic in line with safety risks.	
5.1.2.4. The ADS shall detect and respond to objects and events relevant to its performance of the DDT.	
5.1.2.5. The ADS shall detect and respond to priority vehicles in accordance with the applicable traffic law(s).	
5.1.2.6. The ADS shall comply with traffic rules in accordance with application of relevant law within the area of operation.	
5.1.2.7. The ADS shall interact safely with other road users.	
5.1.2.8. The ADS shall avoid collisions with safety-relevant objects.	
5.1.2.9. The ADS shall signal its operational status if required by applicable laws.	
5.1.2.10. Pursuant to a passenger request under para. 5.2.3.1., the ADS shall bring the vehicle to a safe stop.[45]	
5.1.2.11. The ADS shall have strategies in place to appropriately detect and respond to instructions from road safety agents.	
5.1.3. ADS Performance of the DDT in Critical Traffic Situations	
5.1.3.1. The requirements for DDT performance under nominal situations shall continue to apply during critical situations as far as is reasonably practicable under the specific circumstances with the aim of minimising overall safety risks.	
5.1.3.2. When a collision cannot be avoided, the ADS shall aim to mitigate its severity.	
5.1.3.3. In the event of a collision involving the ADS vehicle, if required to stop by applicable law, the ADS shall stop or fall back to an MRC or bring the vehicle to standstill as appropriate. During this process the user may initiate deactivation of the ADS if the design of the ADS allows.	
5.1.3.2.1. The ADS shall not resume travel unless:	
(a) The safe operational state of the ADS vehicle has been verified, and	
(b) It is permissible under the applicable laws.	

---

[44] It is acknowledged that establishing causation can be complex, and not always possible. However, where it is established that the behaviour of an ADS caused a collision, this is a non-compliance with this requirement.

[45] Para. 5.2.3.1.: "The ADS shall provide the passenger(s) with means to request to stop the vehicle."

UN GTR	UN Regulation
5.1.3.2.2. Notwithstanding para. 5.1.3.2.1.(a), if the collision occurred while an ADS feature of type 2 was active, when directed by a road safety agent, the ADS shall move the vehicle unless the ADS determines that the manoeuvre poses an unreasonable safety risk or is not technically possible due to damage. Alternatively, the safety case shall describe how the road safety agent's instructions will be complied with in such circumstances.	
5.1.4. ADS Performance of the DDT in Failure Situations.	
5.1.4.1. The requirements for DDT performance in nominal situations shall continue to apply during failure situations as far as is reasonably practicable under the specific circumstances with the aim of minimising overall safety risks.	
5.1.4.2. The ADS shall detect faults, malfunctions, and abnormalities that compromise its capability to perform the DDT within the ODD.	
5.1.4.3. In response to a fault, the ADS shall either:	
(a) Execute a fallback response and prohibit activation of the impacted feature(s) if the fault prevents the ADS from performing the DDT in accordance with the requirements under paragraph 5.1., or	
(b) Adapt its performance of the DDT in accordance with the severity of the fault provided the resulting performance complies with the requirements of under paragraph 5.1.	
5.1.4.4. The ADS shall be capable of remote termination.	
5.1.4.4.1. Remote termination for an ADS performing the DDT shall be capable of triggering an ADS fallback response.	
5.1.4.4.2. Remote termination of an ADS or ADS feature(s) shall render it unable to be activated by a user until such time as the remote termination is rescinded.	
5.1.5. ADS Performance of the DDT at ODD Boundaries	
5.1.5.1. The ADS shall recognise the conditions and boundaries of the ODD of its feature(s).	
5.1.5.2. The ADS shall be able to determine when the conditions are met for activation of each feature.	
5.1.5.3. The ADS shall prevent activation of a feature unless the ODD conditions of the feature are met.	
5.1.5.4. The ADS shall execute a fallback response when one or more ODD conditions of the feature in use are no longer met.	
5.1.5.4.1. In response to an ODD exit, ADSF-2 shall aim to bring the ADS vehicle to a stop in a safe location that complies with traffic rules (e.g. a parking space).	
5.1.5.5. The ADS shall be able to anticipate and safely respond to foreseeable exits from the ODD of each feature.	
5.1.6. Fallbacks to a Mitigated Risk Condition	

UN GTR	UN Regulation
5.1.6.1. For ADS features of type 2, the ADS fallback response shall be to place the vehicle in an MRC. The ADS feature may permit a user-initiated deactivation to interrupt the fallback to an MRC.	
5.1.6.2. For ADS features of type 1, if it has not been possible to complete a system-initiated deactivation procedure, the ADS shall execute a fallback to an MRC. During the fallback to MRC the user may initiate deactivation of the ADS.	
5.1.6.3. Upon completion of an ADS fallback to an MRC, a user may be permitted to assume control of the vehicle.	
5.2. Interactions between the ADS and its User(s)	
5.2.1. General requirements	
5.2.1.1. The Safety-relevant information and signals shall be:	
(a) Noticeable by the target user(s) under all operating conditions,	
(b) Comprehensible and unambiguous, and	
(c) Multi-modal (e.g., optical, auditory, haptic) if needed.	
5.2.1.2. The ADS shall signal initiation of a fallback to an MRC to the ADS user(s).	
5.2.1.3. The ADS shall permit a user to override ADS operation of doors in the event of emergency.	
5.2.2. ADS features that permit a user to take over the performance of the DDT.	
5.2.2.1 General requirements	
5.2.2.1.1 The ADS feature shall be designed to prevent misuse and errors in operation by the user.	
5.2.2.1.2. While an ADS feature is active:	
(a) The controls related to manual performance of the DDT shall be disabled, suppressed, or by other means made unavailable in a manner that prevents unsafe interference with the ADS performance of the DDT:	
(i) In the case these controls are suppressed, the ADS shall have strategies in place to prevent ambiguous states of control, or unintentional effect on the DDT.	
(ii) When a user overcomes a suppression threshold a user-initiated deactivation procedure shall commence and must follow the requirements of 5.2.2.3. Overcoming the suppression threshold shall not be the primary means to request a user-initiated deactivation	
(b) devices for indirect vision, tell-tales, and non-ADS-related warnings may be disabled, suppressed, or by other means made unavailable	

UN GTR	UN Regulation
(c) and in the case of an ADS feature of Type 2 direct view to the outside environment may be reduced or compromised. Direct view shall be restored immediately upon the [passenger] requesting deactivation.	
5.2.2.1.3. The vehicle controls dedicated to the ADS shall be clearly identified and distinguishable to accommodate only the appropriate interactions.	
5.2.2.1.4. While an ADS feature is active, it shall inform the user of:	
(a) ADS status information,	
(b) The role of the fallback user in the case of a an ADSF-1, and	
(c) Adapted performance of the DDT consequent to some failure of the ADS.	
5.2.2.1.5. The ADS shall indicate the availability of a feature for activation.	
5.2.2.1.6. While active, an ADSF-1 shall:	
(a) Continuously assess whether the fallback user is available to assume the role of driver. A fallback user is considered available when (i) the user is at least awake, and (ii) correctly seated in such a way as to enable the fallback user to take control of the DDT at the end of the deactivation procedure	
(b) Provide effective procedures for re-engaging the fallback user who has been detected not to be available.	
(c) Trigger a fallback to an MRC where it has not been possible, feasible and/or safe to re-engage the fallback user.	
(d) Ensure the system-initiated deactivation procedure includes sufficient time for the fallback user to perceive the need to take over and to safely re-engage with the driving task.	
5.2.2.2. ADS feature activation	
5.2.2.2.1. The ADS shall ensure a safe ADS feature activation.	
5.2.2.2.2. The ADS shall provide immediate feedback to indicate success or failure when the ADS user attempts to -activate an ADS feature.	
5.2.2.2.3. The feature activation procedure (e.g., sequence of actions and states) shall take into account relevant recommendations or standards.	
5.2.2.2.4. Upon activation of an ADSF-1, the ADS shall immediately and explicitly inform the fallback user of the consequent expectations on them to be ready to respond to a request to resume the DDT.	
5.2.2.2.5. The ADS shall obtain the passenger's consent to perform the role of fallback user before executing a transition from an ADSF-2 to an ADSF-1.	
5.2.2.3. ADS feature deactivation to manual driving	

UN GTR	UN Regulation
5.2.2.3.1 The ADS shall follow a safe ADS feature deactivation procedure.	
5.2.2.3.2 A suggestion from an ADSF-2 that a user might optionally take control shall be considered a user-initiated deactivation if the user accepts the suggestion.	
5.2.2.3.3. Following the user requesting deactivation of the ADS feature, the ADS shall follow a deactivation procedure to safely transfer control of the DDT to the user.	
5.2.2.3.4. The ADS shall respond when the user requests to initiate a system deactivation procedure. The ADS shall only initiate the system deactivation procedure if the ADS verifies that the user is in position to assume the role of the driver.	
5.2.2.3.5. ADS feature deactivation may be delayed if it is assessed by the ADS that the situation is unsuitable or unsafe for the subsequent mode of vehicle operation. In this case, the user shall be informed of this circumstance.	
5.2.2.3.6. The ADS feature shall remain active until the system deactivation procedure has been completed or the ADS vehicle reaches a [mitigated] risk condition.	
5.2.2.3.7. The deactivation procedure (e.g., sequence of actions and states) shall take into account relevant recommendations or standards.	
5.2.2.3.8. The ADS shall assess if the fallback user or the passenger assuming the role of the driver is suitably engaged to resume the DDT before completion of the deactivation procedure.	
5.2.2.3.8.1 A user is considered suitably engaged to resume the DDT when they are at least: i) in contact with the steering control and ii) their gaze has been primarily directed to a driving task relevant area long enough to be able to resume the DDT safely.	
5.2.2.3.8.2 If gaze monitoring is momentarily unavailable other measures substituting gaze monitoring may be used. Such measures shall be described in the safety concept [section].	
5.2.2.3.9. The ADS shall provide a specific indication of the completion of the deactivation of the ADS.	
5.2.2.3.10. At the completion of the deactivation procedure, control shall be returned to the driver without any continuous lateral or longitudinal control assistance active	
5.2.2.3.11. During the deactivation procedure, controls related to manual performance of the DDT, direct view to the outside environment, devices for indirect vision, indicators, warnings, and tell-tales shall be set to an appropriate state for manual driving.	
5.2.2.3.12. If applicable, ADS features operating control of closures shall no longer influence closures or the controls associated with closures.	
5.2.3. ADS features that do not permit a user to take over the performance of the DDT.	
5.2.3.1. The ADS shall provide the passenger(s) with means to request to stop the vehicle.	

UN GTR	UN Regulation
5.2.3.2.	The ADS vehicle shall provide safety-related information to the passengers.	
5.2.3.3.	If safety risks to passengers arise while an ADS feature is active (e.g., safety belts not fastened, passengers not seated), the ADS shall respond according to the strategies described in 6.3.2.12.	
5.2.3.4.	Controls provided for manual driving (e.g., steering, service brake, parking brake, accelerator, lighting) shall be designed to prevent any effect on the DDT whilst the ADS is performing the DDT, or reasonable safeguards shall be put in place to prevent access to controls.	
5.2.4.	Information provision to users who can perform the role of the driver	
5.2.4.1.	Means shall be provided that facilitates user understanding of the functionality and operation of the system.	
5.2.4.1.1.	A description of the ADS features and their capabilities and limitations shall be provided.	
5.2.4.1.2.	Instructions for the activation and deactivation of the ADS feature(s) shall be provided, with clear explanations of the distinctions between user-initiated deactivation and system-initiated deactivation where applicable.	
5.2.4.1.3	A description of the transitions of user roles and the procedure for those transitions, for example, reversion to manual driving following deactivation of the ADS feature shall be provided.	
5.2.4.1.4	Any expectations on the fallback user to be ready to resume the DDT upon request shall be explained.	
5.2.4.1.5	A general overview of non-driving-related activities (NDRA) allowed when an ADS feature is active shall be provided.	
5.2.4.1.6	Information related to the ADS feature(s)' signals shall be provided, covering e.g.:	
	(a) Visual tell-tales, icons	
	(b) Acoustic signals	
	(c) Haptic signals.	
5.2.4.1.7	Information on possible changes in the performance of the DDT by the ADS features following a failure of the ADS shall be provided.	
5.2.4.1.8	Information on how the ADS feature responds to inputs by the user into controls provided for manual driving (e.g., steering, service brake, parking brake, accelerator, lighting), if they are available, shall be provided.	
5.2.4.1.9.	Information on any additional safety precautions in using an ADS feature to be taken by the user shall be provided, such as that owners, operators or drivers should check the condition of tyres and lights.	
5.3.	Other ADS Requirements	
5.3.1.	Data Storage Systems for Automated Driving	

UN GTR	UN Regulation
5.3.1.1. The ADS vehicle shall be equipped with a DSSAD capable of monitoring the safety performance of the ADS in accordance with the provisions of this Regulation	
5.3.2. [Requirements specific to cyber security of ADS installed on vehicles]	
5.3.3. The manufacturer shall include a robust process in the SMS to ensure that post-deployment software updates are properly validated and distributed and downloading is confirmed.	
5.3.4. The ADS shall be designed to protect against unauthorized access to and modification of the ADS features and functions. The measures ensuring protection from unauthorized access shall be provided in alignment with engineering best practices.	
5.3.5 The ADS shall provide an interface for the purposes of maintenance and repair by authorized persons.	
5.3.5.1. For vehicles without manual driving controls, suitable means shall be made available, where necessary (e.g. special controls, test modes, ADS functions) to enable the performance of the physical checks required for mandated inspections of other vehicle systems in the jurisdiction of operation (e.g. Periodical Technical Inspection, safety standards inspection etc.).	
5.3.6 The ADS shall receive and appropriately manage all signals received from other vehicle systems. A list of these signals and how they are managed shall be included in the manufacturer's safety case.	
5.3.7 While a Type 2 feature is active, the ADS shall manage relevant non-DDT-related tasks (which would otherwise be performed by a driver) in accordance with the manufacturer's safety case. Alternatively, where the ADS does not perform such necessary tasks, the safety case shall describe how these tasks are performed.	
6. Manufacturer Requirements	
6.1. Safety Management Systems	
6.1.1. The manufacturer shall establish, implement and document a Safety Management System (SMS).	
6.1.2. Safety Policy	
6.1.2.1. The safety policy shall outline the aims and objectives that the manufacturer uses to achieve the desired safety outcomes.	
6.1.2.2. The manufacturer shall provide evidence that its safety policy implements the following aspects:	
(a) Safety policies and principles (e.g., ISO 21434, para. 5.4.1 and ISO 9001 Automotive 5.2.),	
(b) Organization safety objectives and the process for creating safety performance indicators used in the safety case	
(c) Appropriate structure for the SMS taking into account regulation, standards, best practice guidance and the use-case of the ADS and its features and mapping its organization structure, processes, and work products onto the SMS,	
(d) Safety culture (e.g., ISO 26262-2, para. 5.4.2),	

UN GTR	UN Regulation
(e) Safety governance including management commitment (e.g., ISO 21434, para. 5.4.1 and ISO 9001 Automotive 5.1), clear lines of accountability and roles and responsibilities (e.g., ISO 26262-2, para. 6.4.2, this relates to the organizational and project dependent activities),	
(f) Quality Management System (e.g., IATF 16949 or ISO 9001 to support safety engineering, including change management, configuration management, requirement management, tool management etc.	
6.1.3. Risk Management	
6.1.3.1. The SMS shall include a management process to identify, assess, and mitigate organisational, human, and technical risks.	
6.1.3.1.1. The SMS shall show the link between the overall risk management process, the mitigations, and the resulting operational risks.	
6.1.3.2. The manufacturer shall document its risk-management processes and activities with consideration of relevant standards and best practices, including:	
(a) Risk identification (e.g., ISO 31000 para. 6.2),	
(b) Risk analysis (e.g., ISO 31000 para. 6.3),	
(c) Risk evaluation (e.g., ISO 31000 para. 6.4),	
(d) Risk treatment (e.g., ISO 31000 para. 6.5),	
(e) Processes for keeping the risk assessments up to date,	
(f) Review of safety performance of the organisation and effectiveness of safety risk controls.	
6.1.4. Safety Assurance	
6.1.4.1. The manufacturer shall demonstrate that periodic independent internal audits and external audits are carried out to ensure that the processes established for the Safety Management System are implemented consistently.	
6.1.4.2. The manufacturer shall put in place suitable arrangements (e.g., contractual arrangements, clear interfaces, quality management system) with any organization involved in the development, manufacturing, or in-use deployment of its ADS and its features (e.g., contracted suppliers, service providers, or manufacturers' sub-organizations)	
6.1.4.2.1. The manufacturer shall document its processes and activities, including the following aspects:	
(a) Organizational policy for supply chain,	
(b) Incorporation of risks originating from supply chain,	
(c) Evaluation of supplier SMS capability and corresponding audits,	
(d) Processes to establish contracts, agreements for ensuring safety across the phases of development, production, and post-production,	

UN GTR	UN Regulation
(e) Processes for distributed safety activities, and	
(f) The manufacturer shall have processes for providing safety-relevant information to relevant parties as needed, enabling them to meet their legal obligations.	
6.1.4.3. SMS documentation shall be regularly updated in line with any relevant changes to the SMS processes. Gap analysis shall be used when auditing and updating the SMS, examining the current safety culture before formulating new and more appropriate SMS processes to ensure issues are adequately resolved.	
6.1.4.4. The manufacturer shall have processes for:	
(a) Assuring that all practices and activities documented as part of the SMS are followed,	
(b) Assuring that an independent check of compliance with the applicable requirements is performed. (i.e., not from person creating the compliance data), and	
(c) Assuring the continued evaluation of the Safety Management System so that it remains effective.	
6.1.3.5. The manufacturer shall define appropriate Key Performance Indicators (KPI) to measure the effectiveness of the Safety Management System throughout the ADS lifecycle (development, production, operation and decommissioning).	
6.1.5. Safety Promotion	
6.1.5.1. The SMS shall be subject to a process of continual improvement (e.g. "Plan, Do, Check, Act" as described in ISO 9001). Any changes to SMS documentation should be communicated as required to the relevant authority.	
6.1.5.2. The manufacturer shall institute and maintain: (a) Effective communications within the organization on safety issues (e.g., ISO 26262-2, para. 5.4.2.3); (b) Information sharing outside of the organization (e.g., ISO 21434, para. 5.4.5 and ISO 9001, but from a safety perspective); (c) SMS training plans	
6.1.6. Management of Design and Development	
6.1.6.1. The SMS shall include evidence of the deployment of the safety policy in the Design and Development phase, including the following	
(a) Roles and responsibilities of the people involved during the design and development phase,	
(b) Qualifications and experience of persons responsible for making decisions that affect safety,	
(c) Coordination of roles, responsibilities and information transfer between design and production activities.	
6.1.6.2. The manufacturer shall implement its processes and activities to ensure the robustness of the design and development phase, including the following aspects:	
(a) A general description of how the organization performs all the design and development activities,	

UN GTR	UN Regulation
(b) Vehicle/system design and development, integration, and implementation and safety case processes and activities, including at least to the following	
(i). Requirements management (e.g., requirement capture and validation),	
(ii). Suitability of of the physical testing environment,	
(iii). Credibility of virtual tool chain,	
(iv). Tool Management	
(v). System integration,	
(vi). Software development assurance,	
(vii). Hardware development assurance,	
(viii). Management of functional safety (e.g., ISO 26262) and SOTIF (e.g., ISO 21448), including the ongoing evaluation and update of risk assessments and interactions,	
A) These processes shall include elements like e.g Failure Mode and Effect Analysis (FMEA), Fault Tree Analysis (FTA), System-Theoretic Process Analysis (STPA) or any similar process appropriate to system functional and SOTIF.	
(ix) Management of human factors, including human-centered design processes for safety-relevant interactions (e.g., ISO 9241-210).	
(c) Change management, including but not limited to:	
(i) Major design decisions,	
(ii) ADS design modifications,	
(iii) Changes in key personnel responsible for making decisions that affect safety,	
(iv) Tools and thresholds adopted for ADS safety verification.	
6.1.6.3. The manufacturer shall include effective communication channels between the departments and third-party organizations responsible for functional safety, SOTIF, cybersecurity, and any other relevant disciplines related to the achievement of vehicle safety.	
6.1.6.4. The SMS shall include a process for creating safety performance indicators used in the safety case.	
6.1.7. Management of the Production	

UN GTR	UN Regulation
6.1.7.1. The manufacturer shall establish and document the production process in the SMS. This documentation shall cover, at least, the following aspects:	
(a) Quality Management System accreditation (e.g., IATF 16949 or ISO 9001), and	
(b) A description of the way in which the manufacturer performs all the production functions including management of working conditions, working environment, equipment and tools.	
6.1.7.2 The manufacturer shall establish and document their distributed production processes and activities in the SMS. The processes and activities shall include:	
a) Liaison between the manufacturer and all other organisations (e.g. suppliers, partners or subcontractors) involved in the supply chain.	
b) Criteria for the acceptability of "subsystem/components" manufactured by other partners or subcontractors. (i.e., deployment of production assurance requirements to supply chain).	
c) [Confirmation that safety risks including cybersecurity related to all concerned components/ systems of the vehicle are managed.]	
6.1.8. Management of Post-deployment safety	
6.1.8.1. The manufacturer shall establish processes to demonstrate its capabilities to manage the safety during the post deployment phase, including carrying out ISMR and taking corrective remedial action when necessary.	
6.1.8.2. The processes for ISMR shall demonstrate the capabilities:	
(a) To monitor ADS operations,	
(b) To confirm the compliance with the defined safety case and compliance to the performance requirements,	
(c) To identify safety risks related to ADS performance that need to be addressed in the frame of the SMS activities, including instances of non-compliance with ADS safety requirements,	
(d) To manage potential safety-relevant gaps during the in-service operation and to provide the information that allows the ADS to be updated according to the appropriate manufacturer processes,	
(e) To support the development of new or revise existing scenarios,	
(f) To perform event investigation,	
(g) To report occurrences to the relevant authority when they occur, and	
(h) To share learnings derived from occurrence analysis which have triggered SMS processes for the continuous improvement of the ADS vehicle safety.	

UN GTR	UN Regulation
6.1.8.3. The process for ISMR shall demonstrate the capabilities for handling the reports received from other sources, including distinguishing false reports from actual events and conducting thorough investigations when necessary.	
6.1.8.4. The manufacturer shall demonstrate the capabilities to monitor the performance of all its in-service ADS vehicles.	
6.1.8.5. The manufacturer shall demonstrate the capabilities collect and analyse vehicle data and data from other sources to achieve the ISMR objectives.	
6.1.8.5.1. The manufacturer shall have:	
(a) A data acquisition strategy,	
(b) A data retention strategy, and	
(c) Data access, security, and protection policies	
6.1.8.5.2. The data acquisition strategy shall ensure a representative collection of data to monitor the ADS in service performance.	
6.1.8.5.3. The data retention strategy shall ensure that:	
(a) Data related to a detected safety issue is retained until any necessary corrective action and review processes are complete, and	
(b) The retention of the data for longer-term trend analysis (i.e. subset of the collected data).	
6.1.8.5.4. The data access, security and protection policies shall ensure that information access is allowed only to authorized persons and contains safeguards to ensure the security and protection of the data in accordance with the data-protection laws of the relevant jurisdiction.	
6.1.8.5.5. The manufacturer shall achieve the following objectives from the monitoring activity:	
(a) Verify the safety performance (i.e., Safety Performance Indicators) and confirm the in-service safety level of the system (i.e. metrics and thresholds),	
(b) Identify areas of operational risk,	
(c) Identify when the ADS prevents incidents/accidents (e.g., MRC fallbacks, collision avoidance, emergency manoeuvres),	
(d) Characterise and analyse occurrences,	
(e) Discover trends that suggest the emergence of unacceptable risks,	
(f) Ensure that remedial actions are put in place when an unacceptable risk is discovered or predicted by trends,	
(g) Confirm the effectiveness of any remedial action, and	
(h) Enable the development of new or the revision existing scenarios derived from ISMR activities.	

UN GTR	UN Regulation
6.1.8.5.6. The manufacturer shall perform a data analysis with sufficient frequency so that remedial action can be taken promptly and in line with reporting requirements listed under paragraph 6.4.	
6.1.8.5.7. The analysis techniques shall include at least the following:	
(a) Routine measurements: a selection of parameters shall be collected to characterize the performance of ADS and to allow a comparative analysis. These measurements shall aim at identifying and monitoring emerging trends and tendencies before the trigger levels associated with exceedances are reached.	
(b) Exceedance detection: a set of safety performance indicators shall be selected to cover the main areas of interest for the ADS operation with aim at searching for deviations from safety performance and limits. They shall be continuously reviewed to reflect the current operations.	
(c) Occurrence analysis: It shall be possible to characterize and investigate all the occurrences listed in the Annex 1 using the recorded data.	(c) Occurrence analysis: It shall be possible to characterize and investigate all the occurrences listed in the Annex 3 using the recorded data.
(d) Statistics: Data series shall be collected to support the analysis process with additional information. These data shall provide information to generate rates and trends.	
6.1.8.6. The manufacturer shall have a mechanisms in place for receiving and analysing safety-relevant feedback and reports from other sources to extract safety-relevant information and to review the safety monitoring data.	
6.1.8.6.1. The feedback and reports from other sources shall include at least:	
(a) ADS-related vehicle maintenance and inspection feedback,	
(b) Enforcers (including the police) and other authorities' reports, and	
(c) Service operator, customer, public and dealer feedback.	
6.1.8.7. The manufacturer shall evaluate the results from the monitoring activity to assess:	
(a) In-service safety performance,	
(b) The adequacy of the metrics and thresholds, and	
(c) The outcome of remedial actions.	
6.2. Test Environments	
6.2.1. Virtual Testing	
6.2.1.1. The manufacturer shall describe the intended use(s) of virtual testing and its role in the overall testing strategy.	

UN GTR	UN Regulation
6.2.1.2. The manufacturer shall demonstrate that each simulation toolchain is suitable to use for virtual testing by showing that they fulfil the requirements laid down in the present section.	
6.2.1.2.1. In performing this assessment the manufacturer shall take into account the results of the criticality analysis as described in 6.2.1.9. to produce evidence to support the safety case and for the assessment of ADS compliance with functional/user requirements.	
6.2.1.3. Data Management	
6.2.1.3.1. The manufacturer shall manage the data used to develop, verify, validate and update the simulation toolchain(s) throughout its lifetime. The manufacturer shall consider the completeness, accuracy and consistency of this data.	
6.2.1.3.2. The manufacturer shall maintain a record of the data used in the validation of the toolchain(s).	
6.2.1.3.3. The manufacturer shall describe the measures taken to ensure the quality and integrity of data or tools integrated into the simulation toolchain(s) from organisations that are not under the control of the manufacturer.	
6.2.1.3.4. Management of input data and simulation toolchain(s) parameters	
6.2.1.3.4.1. The manufacturer shall document the input data used to verify, and validate the simulation toolchain(s).	
6.2.1.3.4.2. The documentation shall note important quality characteristics of the input data.	
6.2.1.3.4.3.The documentation shall show that the input data covers the intended ADS functionalities that the virtual testing aims to assess.	
6.2.1.3.4.4. The documentation shall describe the calibration procedures used to fit parameters associated with the simulation toolchain(s);	
6.2.1.3.4.5. The documentation shall explain the reasons for any changes to the data or parameters that occur when a new version of a simulation toolchain(s) is released.	
6.2.1.3.5.The manufacturer shall quantify the uncertainty in the simulation toolchain(s) and its outputs that occur because of the quality of the data (e.g. data coverage, signal to noise ratio, and sensors' uncertainty/bias/sampling rate).	
6.2.1.3.6.Management of output data	
6.2.1.3.6.1. The manufacturer shall record the output data from the simulation toolchain(s) used for its validation	
6.2.1.3.6.2. Each output record shall be traceable to the input data that produced the output.	
6.2.1.3.6.3. The manufacturer shall conduct statistical analysis of the output data and note any important quality characteristics deduced from this analysis.	
6.2.1.3.6.4. The manufacturer shall show that the quality of the output data is sufficient to: (a)validate the simulation toolchain(s) and its components. (b)allow consistency/sanity check of the simulation toolchain(s) and its components; and (c) produce evidence to support the ADS safety case.	
6.2.1.3.6.5 If stochastic models exist in the simulation toolchain(s), with regards to the data generated by these models, the manufacturer shall:	

UN GTR	UN Regulation
a)characterize the variance in the simulation toolchain(s)'s output b)ensure the possibility of a deterministic re-execution of the simulation toolchain(s).	
6.2.1.4. Competency of Personnel	
6.2.1.4.1.The manufacturer shall document and provide the rationale for their confidence in the competency of: a)the personnel that developed the simulation toolchain(s) and its components b)the personnel that assessed the simulation toolchain(s) and its components c)the personnel that used the simulation toolchain(s) to perform the testing with the purpose of validating the system.	
6.2.1.4.2. The manufacturer shall have processes and procedures that identify and maintain the skills, knowledge, and experience needed to develop, assess and use the simulation toolchain(s). The following processes shall be established, maintained and documented: a)process to identify and evaluate the necessary competencies that are required to perform the modelling and simulation activities identified by the manufacturer; b)process for training personnel to be competent to perform the modelling and simulation activities.	
6.2.1.4.3. The manufacturer shall maintain records of the personnel involved in the development, assessment and use of the simulation toolchain(s) showing they have received the necessary training and have been deemed competent to perform the requested modelling and simulation activities.	
6.2.1.4.4. The manufacturer shall set up suitable arrangements with third-party organisations linked to the simulation toolchain(s), to ensure that the competency of the third-party personnel is adequate to perform the tasks assigned to those personnel.	
6.2.1.4.5. The arrangements with third-party organizations shall be aligned with the SMS provisions reported in 6.1.4.2. and 6.1.6.3.	
6.2.1.5. Release Management	
6.2.1.5.1. The manufacturer shall manage and support the simulation toolchain(s) used for virtual testing throughout the lifecycle of the simulation toolchain(s).	
6.2.1.5.1.1.This management and support shall also continue until the end of the post-production phase of the ADS.	
6.2.1.5.2. The manufacturer shall manage and document the simulation toolchain(s) release management process. The simulation toolchain(s) release management activity shall include: a)a description of the modifications associated with each toolchain(s) release b)a record of any associated software (e.g., specific software product, designations and version) and hardware arrangements (e.g., XiL configuration) c)a record of the internal review activities that supported the toolchain(s) acceptance and release.	
6.2.1.6. Description of the Simulation Toolchain	

UN GTR	UN Regulation
6.2.1.6.1. The manufacturer shall describe the simulation toolchain(s) and identify its scope of applicability, its limitations, assumptions and the sources of uncertainty that can affect results.	
6.2.1.6.2. The manufacturer shall provide a description of the simulation toolchain(s) and its components.	
6.2.1.6.3. The manufacturer shall provide a description of the approach adopted in the simulation toolchain(s) validation.	
6.2.1.6.4. The manufacturer shall provide a description of the acceptance tests and criteria that will be used to determine that the simulation toolchain(s) can be used to produce the evidence needed to support the ADS safety case	
6.2.1.7. Simulation Toolchain Assumptions, Known Limitations, and Uncertainty Quantification	
6.2.1.7.1. The manufacturer shall describe the modelling assumptions and considerations that guided the design of the toolchain(s).	
6.2.1.7.2. The manufacturer shall provide information on: a)Assumptions made during the development of each simulation toolchain and its components and the limitations that these place on its scope and applicability b)The rationale for choices made about the level of fidelity of each simulation toolchain and its components.	
6.2.1.7.3. The manufacturer shall provide justification that the tolerances associated with the simulation toolchain(s) are appropriate and meet the acceptance tests and criteria.	
6.2.1.7.4. The manufacturer shall provide details of the sources of uncertainty in each simulation toolchain and its components and the assessment of their impact on the results.	
6.2.1.8. Simulation Toolchain Scope	
6.2.1.8.1. The manufacturer shall document the scope of each simulation toolchain and identify its limitations.	
6.2.1.8.1.1.The scope shall refer to the ODD and identify any limitations about its applicability to the ODD.	
6.2.1.8.2. The manufacturer shall demonstrate how each simulation toolchain imitates the relevant physical phenomena and meets the necessary level of accuracy.	
6.2.1.8.3. The manufacturer shall provide sufficient evidence to justify the claim that the simulation toolchain(s) can be used within the defined scope.	
6.2.1.8.4. The manufacturer shall provide a list of tests used for validation and the corresponding parameters and any known limitations.	
6.2.1.9. Simulation Toolchain Criticality Analysis	
6.2.1.9.1. The manufacturer shall review the error estimates of the simulation toolchain(s) to assess their criticality and the effect these would have on the manufacturer's claims about their safety case.	
6.2.1.10. Simulation Toolchain Verification	
6.2.1.10.1. The manufacturer shall demonstrate that the simulation toolchain(s) will not exhibit unrealistic behaviour for valid inputs which have not been explicitly tested.	
6.2.1.11. Simulation Toolchain Code Verification	

UN GTR	UN Regulation
6.2.1.11.1. The manufacturer shall document the execution of proper code verification techniques used in evaluating each simulation toolchain and its components (e.g., static/dynamic code verification, convergence analysis and comparison with exact solutions if applicable).	
6.2.1.11.2. The manufacturer shall provide evidence that the input parameter space was sufficiently explored to identify if there are any parameter combinations for which the simulation toolchain(s) shows unstable or unrealistic behaviour.	
6.2.1.11.3. The manufacturer shall undertake sanity and consistency checking procedures provide information on the results to show that the simulation toolchain(s) is robust.	
6.2.1.12. Simulation Toolchain Calculation Verification	
6.2.1.12.1. The manufacturer shall document numerical error estimates (e.g., discretization error, rounding error, iterative procedures, and convergence).	
6.2.1.12.2 The manufacturer shall review the analysis and demonstrate that the numerical errors are understood and sufficiently bounded to allow the simulation toolchain(s) to be used for virtual testing.	
6.2.1.13. Simulation Toolchain Sensitivity Analysis	
6.2.1.13.1. The manufacturer shall provide documentation demonstrating that the input data and parameters that most critically influence the toolchain outputs have been identified by means of appropriate sensitivity analysis techniques.	
6.2.1.13.2. The manufacturer shall demonstrate that robust calibration procedures have been adopted for assigning appropriate value(s) to all the simulation parameters while ensuring that special attention is taken for the most critical parameters. This is to ensure that the simulation toolchain can be used to emulate the relevant real-world system.	
6.2.1.13.3. The manufacturer shall demonstrate that sensitivity analysis has been used to identify the critical input data and parameters that need particular attention in order to characterize the uncertainty of the overall simulation toolchain outputs.	
6.2.1.14. Simulation Toolchain Validation	
6.2.1.14.1. The manufacturer shall perform a validation analysis, based on quantitative metrics, to determine the degree to which each simulation toolchain is an accurate representation of the real-world system.	
6.2.1.14.2. The manufacturer shall provide evidence that the simulation toolchain(s) results are consistent and correlated with the results of the physical tests.	
6.2.1.14.3. The validation shall be performed on a sufficiently representative set of tests in order to substantiate the claims that the simulation toolchain(s) is suitable and can be used within its scope.	
6.2.1.14.4. The manufacturer shall define the measures of performance (metrics) that will be used when comparing between the results of physical tests and the output of the simulation toolchain(s).	
6.2.1.14.5. The manufacturer shall use appropriate statistical techniques when comparing the results of physical tests and the corresponding output of the simulation toolchain and its components.	
6.2.1.14.6. The manufacturer shall specify acceptance tests and criteria during the development of each simulation toolchain and its components and demonstrate that they have been achieved.	
6.2.1.14.7. The manufacturer shall define the methodology and tests used for each simulation toolchain validation.	
6.2.1.14.7.1.It should be clear whether the full ODD is within scope of the toolchain(s) or only part of it.	

UN GTR	UN Regulation
6.2.1.14.7.2.The validation strategy may consist of one or more of the following: a)subsystem model validation e.g. environment models, sensor models, and vehicle models; b)vehicle system model validation (vehicle dynamics model together with the environment model); c)sensor system validation (sensor model together with the environment model); d)integrated system validation (sensor model together with the environment model with influences form vehicle model).	
6.2.1.14.8. The manufacturer shall demonstrate that the accuracy criteria defined during each simulation toolchain development have been met.	
6.2.1.14.9. The manufacturer shall provide evidence that the processes related to the validation activity have been followed.	
6.2.1.14.10.The manufacturer shall document their uncertainty characterization analysis and provide information about how the simulation toolchain(s) should be used and any safety margins that should be applied when it is used for virtual testing.	
6.2.1.14.11.The manufacturer shall demonstrate it has techniques to estimate each simulation toolchain's critical inputs and that they have been applied and the results documented	
6.2.1.14.12.The manufacturer shall demonstrate that they have characterised the critical parameters used in each simulation toolchain and its components and where appropriate have identified these as distributions with confidence intervals.	
6.2.1.14.13.The manufacturer shall demonstrate that they have achieved a proper characterization of the uncertainty of the results of each simulation toolchain and its components, because of any assumptions therein.	
6.2.1.14.14.The manufacturer shall demonstrate that they have differentiated between the aleatory and epistemic[46] uncertainties associated with each simulation toolchain.	
6.2.2. Track testing	
6.2.2.1. The manufacturer shall demonstrate that the track testing environment and capabilities are suitable to conduct testing and gather evidence to support the safety case. In particular the manufacturer shall demonstrate that: a)the track testing conducted includes static and dynamic elements representative of the ODD and of the expected operating conditions; b)the equipment used during track testing undergoes periodic inspection, maintenance and calibrations to ensure that the measurements are characterized by sufficient accuracy and precision.	
6.2.3.Real-world testing	
6.2.3.1. The manufacturer shall demonstrate that the real-world testing facilities (public roads), environment and capabilities are suitable to conduct testing and gather evidence to support the safety case. In particular the manufacturer shall demonstrate that:	

[46] "Aleatory Uncertainty" means the portion of uncertainty deriving from a random process that cannot be reduced, while "Epistemic Uncertainty" means the portion of uncertainty deriving from a lack of knowledge about a process that can be reduced via observations.

UN GTR	UN Regulation
a)the selected test routes hold a sufficient probability for the ADS to encounter [situations] that involve a large number of other road users, unlikely road infrastructure, or abnormal geographic/environmental conditions.	
b)the equipment used during real-world testing undergoes periodic inspection, maintenance and calibrations to ensure that the measurements are characterized by sufficient accuracy and precision.	
6.3. Safety Case for the ADS	
6.3.1. System Description	
6.3.1.1. The manufacturer shall provide a system description.	
6.3.1.2. The system description shall describe the type of use(s) for which the ADS is intended, such as personal car ownership, urban taxi fleet, goods transportation, highway use, etc.	
6.3.1.2.1. This shall include a description of each ADS feature configuration including ADS functions applicable to that specific feature, the intended uses and limitations on the use of the feature which gives a simple explanation of its operational characteristics.	
6.3.1.3. The system description shall describe how the Operational Design Domain has been defined for each ADS feature and explain the boundaries of each of the conditions in which the feature is designed to operate. This shall include at least the following:	
(a) Intended area of operation (i.e. Jurisdictions, geographic limitations, etc.)	
(b) Roadway characteristics (i.e. road type, road conditions, speed limit, etc.)	
(c) Environmental conditions (i.e. Weather, illumination, etc.)	
(d) Dynamic elements (i.e. kinds of other road users, etc.)	
6.3.1.4. The system description shall include outlines of the following elements of the ADS and their relationships to other vehicle systems:	
(a) Hardware components and their functions, and	
(b) Software components and their functions.	
6.3.1.4.1 The outlines shall include block diagrams and/or schematics.	
6.3.1.4.1.1. The hardware components outline shall include a schematic of the ADS illustrating the equipment distribution.	
6.3.1.4.1.2. The outlines shall integrate the hardware identification markings of the ADS components in its diagrams and/or schematics and, a table shall be provided to link the hardware identification to the software identification.	
6.3.1.4.1.3. A single hardware identification marking shall be used for functions that are combined within a single component (e.g. control unit or single computer) but are shown in multiple blocks in a block diagram.	

UN GTR	UN Regulation
6.3.1.4.1.4. [The table in 6.3.1.4.1.2 shall be kept up to date with software and hardware updates.]	
6.3.1.4.2. The outlines shall include the components/functions of the ADS and other vehicle systems that are relevant to meeting the requirements of this regulation.	
6.3.1.4.2.1. The outlines shall show interconnections between the components/functions of the ADS and those components/functions and other systems via:	
(a) A circuit diagram for the electrical transmission links,	
(b) A piping diagram for pneumatic and/or hydraulic transmission equipment, and	
(c) A simplified diagrammatic layout for mechanical linkages.	
6.3.1.4.2.2. There shall be a clear correspondence between transmission links in the hardware and software components outline, schematics and/or diagrams and the signals carried between components and systems of the corresponding functions outline, schematics and/or diagrams.	
6.3.1.4.2.3 Priorities of signals on multiplexed data paths shall be stated wherever priority can be an issue affecting performance or safety.	
6.3.1.4.3. The outlines shall include how the following functions and aspects are addressed:	
(a) Sensing and perception of events and objects,	
(b) Decision-making and planning,	
(c) Remote supervision and remote monitoring by a remote supervision centre (if applicable),	
(d) Information display/user interface,	
(e) The data storage system (e.g., Data Storage System for Automated Driving), and	
(f) Redundancies of relevant components and/or connections.	
6.3.1.4.4. The hardware components outline shall provide information regarding the installation options that will be employed for the individual components that comprise the sensing system.	
6.3.1.4.4.1. These options shall include, but are not limited to, the location of the component in/on the vehicle, the material(s) surrounding the component, the dimensioning and geometry of the material surrounding the component, and the surface finish of the materials surrounding the component, once installed in the vehicle.	
6.3.1.4.4.2. The information shall also include installation specifications that are critical to the ADS's performance such as tolerances on installation angle.	
6.3.1.4.4.3. Any changes to the individual components of the sensing system, or the installation options, shall be updated in the documentation.	

UN GTR	UN Regulation
6.3.1.5. A list of all inputs relevant to/for the ADS, including those from sensors, shall be provided and the working range of these defined, along with a description of how each variable is linked to the control functions of the ADS and potential impacts on system behaviour. This shall include the nominal range, and coverage area of each sensor.	
6.3.1.6. A list of all of the ADS outputs shall be provided and an explanation given, in each case, of whether the output directly controls the vehicle or is processed via another vehicle system. The range of control exercised on each variable shall be defined as well as the nominal capabilities of control actuators.	
6.3.1.7. The system description shall describe how the ADS detects and responds to approaching and crossing of ODD boundaries.	
6.3.1.8. The system description shall document:	
(a) The conditions that must be present to permit activation of the feature,	
(b) The conditions that trigger a fallback response,	
(c) The conditions that must be present to permit deactivation of the feature, and	
(d) The conditions which may prompt the user to voluntarily take back control, if applicable.	
6.3.1.9. The system description shall indicate the categories of other road users with whom the ADS is designed to interact (e.g., pedestrians, cyclists, etc).	
6.3.1.10. The system description shall identify the ADS users with whom it is designed to interact and describe the nature of their interaction with the ADS.	
6.3.1.11. If the ADS can request a remote intervention, the system description shall describe the nature and process for such interaction.	
6.3.1.12. The system description shall describe the methods of activating, overriding, or deactivating the ADS feature by any or all of: the ADS user (where relevant), remote intervention (where relevant), passengers (where relevant) or other road users (where relevant).	
6.3.1.13. Data Storage System for Automated Driving	
6.3.1.13.1 In accordance with Annex 6, the manufacturer shall describe the DSSAD installed on the ADS vehicle, including:	6.3.1.13.1 In accordance with Annex 8, the manufacturer shall describe the DSSAD installed on the ADS vehicle, including:
(a) Capability to record time-stamped data,	
(b) Capability to record time-series data,	
(c) List of recordable data elements,	

UN GTR	UN Regulation
(d) Means for enabling access to stored data, and	
(e) Means for protecting data against unauthorized access and manipulation.	
6.3.1.13.2 [The manufacturer shall justify the omission of data elements listed in Annex 6.]	6.3.1.13.2 [The manufacturer shall justify the omission of data elements listed in Annex 8.]
6.3.1.14. The system description shall describe the range of end states constituting a mitigated risk condition that can be achieved by the ADS feature. This shall include:	
(a) The conditions which may trigger an attempt to reach a mitigated risk condition,	
(b) The processes by which the ADS feature attempts to reach a mitigated risk condition, and	
(c) The evaluation of risk related to mitigated risk condition end states.	
6.3.1.15. The system description shall describe the range of end states constituting a mitigated risk condition that can be achieved by the ADS feature. This shall include:	
(a) A list of the potential faults identifable by the diagnostic system(s) of the ADS feature, and	
(b) Failure of a vehicle system or component other than the ADS that precludes the ADS from performing the DDT.	
6.3.1.16. The system description shall describe how the ADS feature responds to failure situations, including at least one or more following means (as applicable):	
(a) Fallback (or fail safe) operation using a partial system,	
(b) Redundancy using separate systems,	
(c) Diversity of systems performing the same function.	
(d) Removal of some or all automated driving function(s),	
6.3.1.16.1. If a partial performance mode of operation is used under certain fault conditions (e.g. in case of severe failures), The system description shall describe:	
(a) the conditions for activation of that mode (e.g. type of failure),	
(b) the resulting ADS feature behaviour and capabilities (e.g. achievement of a [mitigated] risk condition immediately), and	
(c) the warning strategy to the user/remote supervision centre (if applicable).	

UN GTR	UN Regulation
6.3.1.16.2. If a second (backup) or a diverse means or a diverse means to realize the performance of the dynamic driving task is used, the system description shall describe:	
(a) the principles of the change-over mechanism,	
(b) the logic and level of redundancy and any built-in checking features,	
(c) the resulting limits of effectiveness.	
6.3.1.16.3. If the chosen response to a system failure entails the removal of an ADS function, the system description shall describe how it is done in compliance with the relevant provisions of this regulation. It shall also describe how all the corresponding output control signals associated with this function are inhibited.	
6.3.2. Safety Concept	
6.3.2.1. The manufacturer shall document its safety concept which shall include the risks identified according to the SMS processes in 6.1.3 relevant to the ADS and shall include how those risks have been reduced, mitigated or accepted.	
6.3.2.1.1 The safety concept shall demonstrate the manufacturer's use of processes with top down (from possible hazard to design) and bottom-up approaches (from design to possible hazards) in its identification of hazards.	
6.3.2.2. The safety concept shall describe how the ADS features detect, identify, and respond to hazards, including the following:	
(a) Detection and identification of hazards,	
(b) Design provisions for SOTIF and functional safety (e.g. redundancies),	
(c) An analysis which shows how the ADS will behave (e.g. control strategies) to mitigate or avoid hazards which can have a bearing on the safety of the ADS user(s) and other road users, and	
(d) An analysis that shows how unknown hazardous scenarios and situations will be managed.	
6.3.2.3. The safety concept shall describe the process the ADS uses to determine if a collision with an object would cause non-trivial damage	
6.3.2.4. The safety concept shall describe the ADS's strategy for determining if the ADS vehicle has collided with a safety-relevant object.	
6.3.2.5. [The safety concept shall describe measures taken to assure the cybersecurity of the ADS and the analysis performed to identify and disposition likely security threats. Where UN R 155 applies, the manufacturer shall describe how the ADS meets the requirements of that regulation.]	
6.3.2.6. [Software updates & Safety Case updates as per 6.1.4.3]	
6.3.2.7. [The safety concept shall describe how software updates are validated and confirmed. Where UN R 156 applies, the manufacturer shall describe how the ADS meets the requirements of that regulation. in accordance with SMS section] [6.1.4.3.]	

UN GTR	UN Regulation
6.3.2.8. The safety concept shall describe how the ADS determines the presence/absence of the conditions stated in 6.3.1.3. and any linked/dependent conditions (e.g. reduced speed in icy weather).	
6.3.2.9. The safety concept shall describe the conditions that the automated driving system is reasonably likely to encounter on its trip(s), including, but not limited to, environmental and geographical conditions, and/or the presence or absence of certain traffic or roadway characteristics, and explain how those expected conditions compare to the ODD of the ADS as described in 6.3.1.3.	
6.3.2.10. The safety concept shall describe measures or strategies, if any, implemented to:	
(a) prevent or mitigate abuse/misuse and errors by occupants that could affect safe performance of the DDT (e.g. occupants attempting to access driving controls),	
(b) Prevent, mitigate or deter harm to occupants caused by external sources (e.g. unauthorised persons attempting to access a vehicle with occupants), and	
(c) Prevent, mitigate or deter abuse/misuse of the vehicle or its systems from external sources. (e.g. Objects placed on vehicles during operation, attempts to damage a vehicle).	
6.3.2.11. The safety concept shall describe strategies to limit sudden ODD exits and frequent activation/deactivation situations.	
6.3.2.12 The safety case shall include a list of safety risks to passengers (e.g., safety belts not fastened, passengers not seated) and a description of how they are managed for all passengers, while an ADS feature is active.	
6.3.2.13 The safety concept shall describe the strategies in place to avoid operating the vehicle when the general working condition of the vehicle is not satisfactory (e.g. condition of tyres, brakes, lighting, status of external loads, steering, etc.). These strategies may include technological solutions, physical inspections or other relevant solutions.	
6.3.2.14. Data Storage System for Automated Driving	
6.3.2.14.1. The manufacturer shall provide evidence demonstrating the following:	
(a) Recording of the data elements listed under 6.3.1.13.1.(c),	
(b) Storage of recorded data in accordance with Annex 6.	(b) Storage of recorded data in accordance with Annex 8.
6.3.2.15 The safety concept shall describe the approach used by the manufacturer to derive behavioural competencies and scenarios that are ODD-relevant	
6.3.2.15.1 The manufacturer may refer to the methodology outlined in the Annex [ODD framework annex] as a suitable approach to derive behavioral competencies and scenarios that are ODD-relevant or alternative methods providing they are equally comprehensive.	

UN GTR	UN Regulation
6.3.2.16. The safety concept shall describe the scenarios identification and generation approach and how that approach addresses the following :	
a) coverage of the appropriate nominal, critical and failure [situations]	
b) use of data driven, knowledge driven and stochastic approaches to systematically identify hazardous events and other occurrences	
c) inclusion of elements (especially dynamic elements) that are representative of existing traffic conditions in the expected operating conditions	
d) incorporate the identified characteristics and behaviours of all the relevant scenario elements.	
6.3.2.17 The safety concept shall describe the manufacturer's scenarios selection approach to cover the reasonably foreseeable situations and conditions that the ADS will encounter including how the following aspects are covered:	
a) the selection of sufficient scenarios in which the ADS needs to initiate a fall-back response (e.g. approaching the ODD limits).	
b) reasonably foreseeable [scenarios/situations] that are not deemed to be preventable by the ADS (e.g. related to unsafe behaviour by other road users or by infrastructural failures)	
c) the use appropriate techniques to explore the parameter space when choosing concrete scenarios.	
6.3.2.18 The safety case shall describe how the manufacturer has determined the suitability of processes, resources and competent personnel in place to:	
a) design and undertake the testing that produces the evidence supporting the ADS safety case.	
b) to select and combine static and dynamic elements of a test track for correctly reproducing the conditions of the scenarios selected to track testing.	

UN GTR	UN Regulation
c) to identify test routes that capture predictable aspects of the ODD (e.g., road types and geometries), elements found in the related nominal [situations] (e.g., other road users, signs, and signals), and typical dynamic conditions (e.g., high/low traffic densities). The test routes shall also enable verification of nominal requirements for the safety of user interactions, including prior to, at the time of, and after entering and exiting the ODD of an ADS feature	
d) to assess the behavioural competencies demonstrated by the ADS for each scenario, against the performance requirements of the Dynamic Driving Task (DDT)	
e) to assess the capability of the ADS to ensure the safety of users and the safe use of the ADS.	
6.3.2.19. The safety concept shall include the following information:	
(a) Verification and validation plans including metrics and targets:	
(i) An explanation how [scenarios and situations] are selected as part of verification and validation to provide reasonable coverage of the ODD and its boundaries,	
(ii) Methodology, metrics and targets used to determine reasonable ODD coverage,	
(iii) Any analysis comparing the performance of an ADS feature to that of a manually driven vehicle of comparable category (e.g. category M1 or category 1-1) in situations within the ODD of the feature and,	
(iv) Identification of any metrics or targets resulting from the analysis in (iii).	
(b) Scoring/evaluation methodology to obtain metrics,	
(c) Justification of the chosen acceptance criteria for metrics, and	
(d) Verification and validation results including evidence that the targets have been met (i.e. metrics meet acceptance criteria)	
6.3.3. Claims, Arguments, and Evidence	
6.3.3.1. The safety case shall include a series of claims for each of which there must be at least one supporting argument.	
6.3.3.1.1. Each argument shall be supported by at least one piece of evidence.	
6.3.3.1.2. Each claim, argument and evidence shall be uniquely labelled but may be used more than once (i.e. a piece of evidence may support more than one argument).	
6.3.3.2. The claims, arguments and evidence shall be understandable, logical, correct and robust and shall demonstrate that:	

UN GTR	UN Regulation
(a) the ADS is free of unreasonable risk to ADS user(s) and other road users and	
(b) the ADS meets applicable requirements of this regulation in each of following areas:	
(i) DDT requirements (5.1)	
(ii) User Interactions (5.2), except for the user information requirements of 5.2.5.	
(iii) Other Requirements (5.3)	
6.3.3.3. The following summary information shall be provided with regards to the claims, arguments and evidence:	
(a) A summary identifying the relationships between claims and their supporting argument and evidence, and	
(b) A summary identifying each regulatory requirement noted above and the claims that demonstrate the requirement is met.	
6.3.3.4. The claims, arguments and evidence shall describe how the SMS processes (section 6.1) have been applied to manage ADS safety throughout the lifecycle of the system.	
6.3.3.5. Relevant assumptions made in relation to claims, arguments and evidence shall be stated.	
6.3.3.6. The claims, arguments and evidence shall demonstrate that the approach to testing is suitable for the demonstration of the safety case and the compliance with performance/functional requirements.	
6.3.3.7. Each requirement defined under 6.3.3.2, 6.3.3.4, 6.3.3.6 and as may be defined by the manufacturer shall have at least a claim.	
6.3.3.7.1. Multiple sub-claims for a claim may be created, where a broader claim may not be sufficient or where additional justification is warranted as long as said sub-claims are sequenced logically and their relationships are included in the summary documents.	
6.3.3.8. Each argument supporting a claim shall provide contextual information and supporting information that explains how a claim is met based on an appropriate set of evidence.	
6.3.3.9. Evidence supporting argumentation shall consist of test results or analysis (e.g. system layout and schematics, photographs, required documentation etc.) as appropriate.	
6.3.3.9.1 The test environment used to generate evidence shall meet the requirements of 6.2.1 for virtual tests, 6.2.2. for track tests, and 6.2.3 for real-world tests.	
6.3.3.9.2. Testing results may be provided individually or on aggregate and shall include appropriate acceptance criteria.	
6.3.3.9.3. Each test shall include enough information or be recorded in such a way that it may be reproduced upon request (e.g. same software/hardware versions, same tool versions, same scenario, same parameters etc.).	

UN GTR	UN Regulation
6.3.3.9.3.1. The manufacturer shall facilitate access and execution of the necessary tools and analysis software upon request by the authority for the purpose of reproducing this evidence as part of the approval process or during compliance verification.	
6.3.4 Manufacturer's Review of its Safety Case	
6.3.4.1. As part of the manufacturer's demonstration of compliance to 6.1.4, the manufacturer shall review its safety case prior to certification/approval and is encouraged do so during the development process.	
6.3.4.2. The reviewer(s) shall be independent, meaning that they are free from conditions that would threaten their ability to review the Safety Case without bias.	
6.3.4.4. The reviewer(s) may be internal or external to the manufacturer.	
6.3.4.5. The review shall be documented, available for inspection and include:	
(a) Qualifications of the reviewer/ review team,	
(b) Date/period of review, version of: the safety case, tools and ADS reviewed,	
(c) Methods used to review the Safety Case,	
(d) Listing of any evidence repeated/reproduced, and	
(e) Identified gaps, questions or areas of lower confidence or unknowns	
6.3.4.6. Following each review, and after a time of the manufacturer's choice but before assessment of compliance, the manufacturer shall include in their review documentation the steps taken to remediate or improve upon any findings (e.g. release notes).	
6.4. Post-deployment Safety	
6.4.1. The manufacturer shall provide reports on the in-service safety performance of its ADS vehicles to enable:	
(a) Monitoring implementation of the SMS processes required under paragraphs 6.1.4. and 6.1.8. of this Regulation,	
(b) Monitoring of ADS performance for consistency with the claims evidenced in the safety case of the ADS under paragraph 6.3.3. of this Regulation, and	
(c) Identification of safety concerns in need of remedy,	
6.4.2.1. The reporting by the manufacturer shall be conducted in accordance with the laws of the Contracting Party or Parties with jurisdiction over the reporting, including but not necessarily limited to laws governing:	
(a) Data access	
(b) Data privacy, and	

UN GTR		UN Regulation	
	(c) Data protection.		
6.4.3.	The reporting by the manufacturer shall be based upon information known to the manufacturer		
6.4.4.	The manufacturer shall provide initial notifications, short-term reports, and periodic reports to the relevant authority.		
6.4.5.	The manufacturer shall provide the supporting data underpinning the report by means of an agreed data exchange mechanism upon request by the relevant authority.		
6.4.6.	The manufacturer shall provide the relevant authority with a description of the data processing (for example: filtering and conditioning) procedure and agree on the steps undertaken to deliver the data supporting the report.		
6.4.1.7.	The manufacturer shall report occurrences when at least one of the following is fulfilled:		
	(a) An ADS feature was active when the ADS vehicle was involved in the occurrence, or		
	(b) An ADS feature was active up to 30 seconds prior to the ADS vehicle experiencing the occurrence.		
6.4.8.	Initial notifications		
6.4.8.1.	The manufacturer shall notify the relevant authority of a critical occurrence without unreasonable delay in accordance with the applicable laws after becoming aware of it.		
6.4.8.2.	The initial notification may be limited to high-level data (e.g., location, time, type of accident).		
6.4.9.	Short-term reporting		
6.4.9.1.	The manufacturer shall provide short-term reports for the significant and critical occurrences listed in Annex 1.	6.4.9.1	The manufacturer shall provide short-term reports for the significant and critical occurrences listed in Annex 3.
6.4.9.2.	The manufacturer shall issue each short-term report within 30 days from its knowledge of the occurrence.		
6.4.9.3.	The manufacturer shall report the occurrences in accordance with the template provided in Annex 2.	6.4.9.3.	The manufacturer shall report the occurrences in accordance with the template provided in Annex 4.
6.4.10.	Periodic reporting		
6.4.10.1.	The manufacturer shall provide periodic reports for the occurrences listed in Annex 1.	6.4.10.1.	The manufacturer shall provide periodic reports for the occurrences listed in Annex 3.
6.4.10.2.	The periodic report shall provide evidence of the in-service ADS safety performance. In particular, it shall demonstrate that:		
	(a) The ADS fulfils the performance requirements as evaluated in the test methods and/or declared in the safety case,		

UN GTR	UN Regulation
(b) No inconsistencies have been detected compared to the ADS safety performance declared prior to market introduction, and	
(c) Any newly discovered significant ADS safety performance issues that pose an unreasonable risk to safety have been adequately addressed and how this was achieved, including how they were addressed.	
6.4.10.3. The manufacturer shall submit periodic reporting regularly, at least every year, in the form of aggregated data (e.g., per hour of operation and distance driven) for ADS-vehicle type and related to ADS operation.	
6.4.10.4. The manufacturer shall provide the periodic report in accordance with the template provided in Annex 3.	6.4.10.4. The manufacturer shall provide the periodic report in accordance with the template provided in Annex 5.
6.5. Other Manufacturer Requirements	
6.5.1 The manufacturer shall make available the extent, timing and frequency of maintenance operations necessary for safe ADS performance to the vehicle owner or operator	
7. Compliance Assessments	
7.1. Audit of the Safety Management System	
7.1.1. The documentation of the manufacturer's safety management system shall be audited for compliance with the requirements under paragraph 6.1.	
7.1.2. The audit of the manufacturer's safety management system shall provide evidence on the robustness of the manufacturer's processes to manage safety risks and to ensure safety throughout the ADS lifecycle (development, production, post-deployment)	
7.1.4. The auditor shall evaluate the robustness of the manufacturer's processes to monitor the safety management system activities (KPIs) and to take appropriate (corrective or preventive) action to address any issue.	
7.1.5. The audit of the safety management system shall be conducted by auditors with the technical and administrative knowledge necessary for such purposes. This competence shall be demonstrated by appropriate qualifications or other equivalent training records.	
7.1.6. Audit of the Safety policy	
7.1.6.1 The Auditor shall ensure that the following aspects are covered: a. Definition of the principles and objectives upon which the SMS is built, operated and maintained. b. General recognition of the inherent risks of ADS-related activities throughout their life cycle, including the risks of the parties involved c. Organizational structure and the Safety governance elements and their appropriateness for the needs of the Organization d. Evidence on the commitment towards the safety. e. Description of the means/approaches to engage people within the organization in the culture of safety.	

UN GTR	UN Regulation
7.1.7.　　Audit of the Risk Management	
7.1.7.1　　The Auditor shall ensure that the following aspects are covered: 　　　a. Reactive and proactive practices for risk management are in place 　　　b. Risk management activity is not limited to the ADS itself but includes risk arising from organization/people which can affect the SMS effectiveness or ADS's Safety 　　　c. Risk management activity includes risks from third parties 　　　d. Risk management activity covers and is performed over the entire lifecycle	
7.1.8.　　Audit of the Safety Assurance	
7.1.8.1　　The Auditor shall ensure that the following aspects are covered 　　　a. Periodic independent internal audits and external audits 　　　b. Processes for the management of the supply chain and any other involved organization which can affect the safety of the ADS 　　　c. Change management processes are in place 　　　d. Processes for corrective actions to maintain an acceptable level of safety are in place 　　　e. The corrective action applies to the ADS as well as SMS 　　　f. Monitoring practices to measure overall safety performance are in place. 　　　g. The monitoring practices/processes apply to the ADS as well as to the SMS 　　　h. Independent functions for carrying out the compliance assessment and audit are in place	
7.1.9.　　Audit of the Safety Promotion	
7.1.9.1　　The Auditor shall ensure that the following aspects are covered: 　　　a. There is an appropriate level of competence of the personnel to perform their duties. 　　　b. The competence is promoted through training 　　　c. Means for internal and external safety communications are in place 　　　d. Process for continuous improvement	
7.1.10.　　Audit of Design and Development	
7.1.10.1　　The Auditor shall ensure that following aspects are covered: 　　　a. Processes for the management of Design and development Phase 　　　b. Evidence of the embodiment of the safety policy, risk management, safety assurance and safety promotion aspects in the Design and Development	
7.1.11.　　Audit of Production processes	

UN GTR		UN Regulation	

7.1.11.1	The Auditor shall ensure that following aspects are covered:
	    a. Processes for the management of Production Phase
	    b. Evidence of the embodiment of the safety policy, risk management, safety assurance and safety promotion aspects in the Production		

7.1.12.	Audit post deployment processes		

7.1.12.1	The Auditor shall ensure that following aspects are covered:
	    c. Processes for the management of Post deployment Phase
	    d. Evidence of the embodiment of the safety policy, risk management, safety assurance and safety promotion aspects in Post deployment Phase		

7.1.12.2	Audit of In-Service Monitoring and Reporting		
7.1.4.1.	The manufacture's documentation shall be reviewed to verify the suitability of ISMR practices for the ADS.	7.1.4.1.	The approval authority or its designated technical service shall review the manufacturer's documentation to ensure the suitability of ISMR practices for the ADS.
7.1.4.2.	The documentation review shall provide evidence that:		
	(a) the processes for ISMR are suitable for the ADS,		
	(b) the tools used for ISMR are suitable for the ADS, and		
	(c) the personnel for ISMR have an adequate level of competence.		
7.1.4.3.	The manufacturer's capability to monitor the ADS shall be evaluated for compliance with the requirements under paragraphs 6.1.8.1. through 6.1.8.7.	7.1.4.3.	The approval authority or its designated technical service shall verify the manufacturer's capability to monitor the ADS in accordance with the requirements under paragraphs 6.1.8.1. through 6.1.8.7.
7.1.4.4.	The manufacturer's approach/methods shall be evaluated:	7.1.4.4.	The approval authority or its designated technical service shall evaluate the manufacturer's approach/methods:
	(a) To verify the safety performance of the ADS during the operation, and		
	(b) To ensure the effectiveness of their safety risk controls.		

UN GTR		UN Regulation	
7.1.4.5.	The audit shall verify and evaluate that the manufacturer has a mechanism in place:	7.1.4.5.	The approval authority or its designated technical service shall verify and evaluate that the manufacturer has a mechanism in place:
	(a) To collect data from the vehicle and to receive data other sources, and		
	(b) To utilize all relevant data feeding sources in order to assess the ADS safety risks, evaluate its safety performance, and, in time, take appropriate actions and check their effectiveness.		
7.1.4.6.	The documentation review shall provide evidence that, at least:		
	(a) Responsibilities and timelines are defined to ensure that the monitoring is applied and effective,		
	(b) Methods for data collection and analysis are adequate to ensure monitoring objectives are fulfilled,		
	(c) ADS safety performance will be verified in reference to the safety performance indicators and safety performance targets as indicated in the safety case,		
	(d) The risks are managed and controlled based on the information coming from the monitoring activities,		
	(e) The monitoring takes into account feedback and information received from sources other than the ADS vehicle data, and		
	(f) The effectiveness of the monitoring activity will be regularly reviewed.		
7.1.4.7.	The manufacturer's capability to report the occurrences listed in Annex 1 shall be verified.	7.1.4.7.	The approval authority or its designated technical service shall verify the manufacturer's capability to report the occurrences listed in Annex 3.
7.1.4.8.	The manufacturer's approach/methods for reporting the occurrences experienced by the ADS during the operation and for assessing the cause of such events shall be evaluated.	7.1.4.8.	The approcal authority or its designated technical service shall evaluate the manufacturer approach/methods for reporting the occurrences experienced by the ADS during the operation and for assessing the cause of such events.
7.1.4.9.	Use of the reporting templates in Annex 4 and Annex 5 by the manufacturer shall be verified.	7.1.4.9.	The approval authority or its designated technical service shall verify that the manufacturer utilizes the reporting templates provided in Annex 4 and Annex 5.
7.1.4.10.	The data, metrics, and other information that the manufacturer intends to use for the characterisation of the occurrences shall be evaluated for adequacy.	7.1.4.10.	The approval authority or its designated technical service shall evaluate the adequacy of the information that the manufacturer intends to use for the characterisation of the occurrences (e.g. data elements and metrics).
7.2.	Assessment of the Test Environments		
7.2.1.	Virtual testing environment		

UN GTR	UN Regulation
7.2.1.1 The assessor shall verify that the simulation toolchain(s) used by the manufacturer is suitable for conducting virtual tests and in compliance with requirements listed in 6.2.1. and sub-paragraphs	
7.2.1.2. The assessor shall review the documentation provided by the manufacturer to determine whether the simulation toolchain(s) is suitable to undertake virtual testing.	
7.2. 1.2.1. The assessor shall review the documentation and evidence supporting the manufacturer's claims about the simulation toolchain(s) capability and its scope	
7.2.1.2.2. The assessor may request to witness the execution of the simulation toolchain(s) and the generation of results to verify the evidence produced by the manufacturer and to understand the use of the simulation toolchain(s).	
7.2.1.2.3. The assessor shall audit the information provided by the manufacturer and may request additional testing to verify their claims. The results of the audit and from any additional tests shall be reviewed and any concerns or discrepancies shall be documented and reviewed with the manufacturer.	
7.2.1.2.3.1. If the assessor is unable to confirm that there is an appropriate level of consistency between the information provided by the results and those of the manufacturer or raise other concerns and the manufacturer cannot provide a reasonable explanation for the discrepancies then the assessor shall inform the manufacturer that they need to undertake their own review to identify the reasons.	
7.2.1.2.3.2. The manufacturer can resubmit once they have identified and resolved the issues and updated the information and evidence. The manufacturer shall explain the issue and its impact. The assessor shall conduct a further review that will include an assessment of the additional information supplied by the manufacturer	
7.2.1.2.4. The assessor shall document their finding and if successful the simulation toolchain(s) will be accepted as suitable to undertake virtual testing. If not and the manufacturer cannot provide an explanation for any gaps or discrepancies then the assessor shall provide their finding to the manufacturer and inform them that they need to undertake their own internal review to identify the underlying causes.	
7.2.2 Track Testing	
7.2.2.1 The track testing facilities, environment and capabilities used to generate the evidence to support the safety case claims shall be assessed for compliance with the provisions under paragraph 6.2.2. and sub-paragraphs.	
7.2.2.2 The assessor may request to witness the execution of some of the track tests performed by the manufacturer to confirm compliance with the provisions under paragraph 6.2.2. and sub-paragraphs.	
7.2.3. Real-world testing	
7.2.3.1. The real-world testing facilities, environment and capabilities used to generate the evidence to support the safety case claims shall be assessed for compliance with the provisions under paragraph 6.2.3. and sub-paragraphs.	
7.2.3.2. The assessor may request to witness the execution of some of the real-world tests performed by the manufacturer to confirm compliance with the provisions under paragraph 6.2.3. and sub-paragraphs.	

UN GTR	UN Regulation
7.3. Assessment of the Safety Case	
7.3.1. Assessment of the Safety Case Content	
7.3.1.1. The safety case shall be assessed by an assessor, or team of assessors meeting 7.3.1.6 and 7.3.1.7 in order to determine if the Safety Case is complete and robust.	
7.3.1.2. The assessor may request that the manufacturer provide supporting documentation, assist in repeating/reproducing evidence or subject the ADS to confirmatory tests the assessor deems necessary for this task.	
7.3.1.3. The assessor shall review the manufacturer's safety case for completeness ensuring that at least the following criteria have been met:	
(a) The manufacturer's safety concept is consistent and complete,	
(b) Each requirement in the regulation has been addressed by one or more claims as per 6.3.3.7,	
(c) The cumulation of claims would yield a system absent of unreasonable risk as per 6.3.2.1, 6.3.2.19 and 6.3.3.2.,	
(d) Each claim is supported by one or more arguments as per 6.3.3.1.,	
(e) Each argument is supported by a non-zero set of evidence as per 6.3.3.1.1.,	
(f) The manufacturer has documented metrics and acceptance criteria related to their claims as per 6.3.2.19, and,	
(g) backwards and forward traceability from requirements to evidence as per 6.3.3.3	
7.3.1.4. The assessor shall review the manufacturer's safety case for robustness ensuring that at least the following criteria have been met:	
(a) All identified risks in the Safety Concept are either reduced, mitigated or accepted and the sum of risk (quantitative or qualitative) is below the unreasonable risk threshold,	
(b) The integrity level used for development, verification and validation of the ADS and its features is appropriate to reduce the risk below the unreasonable risk threshold,	
(c) Testing evidence and the tools by which they are obtained achieve an acceptable level of credibility and demonstrate stability of performance when subjected to variations as per 7.2,	
(d) [Acceptable mix of physical, track and virtual testing – as part of credibility? Manufacturer justification?],	
(e) The manufacturer has taken steps to limit the potential for unintended functions in the ADS or for unintended functions to be induced in interfacing systems	
(f) Testing evidence provided can be repeated and reproduced with consistency of safety objectives as per 7.3.2,	

UN GTR		UN Regulation	
	(g) The testing evidence demonstrated by the manufacturer provides reasonable coverage of foreseeable operating conditions and events in the intended area of operation, including conditions consistent with the ODD of the ADS and conditions that may involve ODD exit., and		
	(h) The manufacturer has conducted one or more self-assessments and has taken steps to remediate any findings as per 6.3.4.		
7.3.1.5.	The assessor shall prepare a report of its assessment in such a manner that allows traceability, e.g. versions of documents inspected are coded and listed in the records of the Assessor. The report shall include any identified discrepancies/gaps and remediations undertaken by the manufacturer.		
7.3.1.6.	The assessment shall be conducted by assessors with the technical and administrative knowledge necessary for such purposes. They shall be competent as assessor for functional safety (e.g. ISO 26262), safety of the intended functionality (e.g. ISO/PAS 21448), human factors considerations and shall be able to make the necessary link with cybersecurity (e.g. UN R155, ISO/SAE 21434). This competence should be demonstrated by appropriate qualifications or other equivalent training records.		
7.3.1.7.	The assessors shall be free from conditions that would threaten their ability to assess the Safety Case without bias including:	7.3.1.7.	The assessor shall be independent and external in accordance with Schedule 2 part 1.4 of the 1958 agreement
(a) Financial incentives linked to the approval of the Safety Case (excludes incentives for the work undertaken to assess the Safety Case)			
(b) Participated in the development of the Safety Case via creation of evidence, analyses, test tools or other material,			
(c) Potential of reprisals for not approving the Safety Case.			
7.3.1.8.	[Assessment of the DSSAD]		
7.3.1.8.1	[The documentation furnished under paragraph 6.3.1.13. shall be verified for consistency with the provisions of Annex 6.]	7.3.1.8.1	[The documentation furnished under paragraph 6.3.1.13. shall be verified for consistency with the provisions of Annex 8.]
7.3.2.	Assessment of Safety Case Testing Activities		
7.3.2.1.	General provisions		
7.3.2.1.1.	The assessor shall verify that the approach to testing adopted by the manufacturer is suitable for the demonstration of the safety case and the compliance with performance/functional requirements.		

UN GTR	UN Regulation
7.3.2.1.2. The assessor shall verify that the combined coverage of the testing results from all pillars (virtual, track, real world) is sufficient to support the ADS safety case claims.	
7.3.2.2. Assessment of the scenarios and their management.	
7.3.2.2.1. The assessor shall verify that the manufacturer has used suitable and documented processes to derive behavioural competencies that are relevant to both the ODD and to the ADS safety case[47]	
7.3.2.2.2. The assessor shall verify that the manufacturer's approach and processes to identify and generate scenarios is appropriate. In particular, the resulting scenarios shall:	
a) cover the appropriate nominal, critical and failure situations;	
b) use data driven, knowledge driven and stochastic approaches to systematically identify hazardous events and other occurrences;	
c) include elements (especially dynamic elements) that are representative of existing traffic conditions in the expected operating conditions;	
d) incorporate the identified characteristics and behaviours of all the relevant scenario elements	
7.3.2.2.3. The assessor shall verify that the set of [scenarios and situations] resulting from the manufacturer's scenario generation and identification process is suitable for demonstrating the ADS safety case. This includes covering reasonably foreseeable situations and conditions that the ADS will encounter during its real-world operations[48]. In particular the assessor shall verify that the set of [scenarios and situations] selected as evidence to support the ADS safety case includes:	
a) scenarios in which the ADS needs to initiate a fall-back response (e.g. approaching the ODD limits)	
b) reasonably foreseeable [scenarios and situations] that are not deemed to be preventable by the ADS (e.g. related to unsafe behaviour by other road users or by infrastructural failures)	
7.3.2.2.4. The assessor shall verify that the manufacturer has adopted appropriate techniques to explore the parameter space when choosing concrete scenarios.	
7.3.2.3. Assessment of the processes in place for testing	

---

[47] The methodology in the Annex [X] is one suitable process against which to review the process adopted by the manufacturer.

[48] The methodology in the Annex [XX – DDT Annex], including the provided scenario template, is one suitable approach against which to review the approach adopted by the manufacturer

UN GTR	UN Regulation
7.3.2.3.1. The assessor shall verify that the manufacturer has suitable processes, resources and competent personnel who can design the testing that produces the evidence supporting the ADS safety case	
7.3.2.3.1.1. The assessor shall verify that the manufacturer has suitable processes in place to select and combine static and dynamic elements of a test track for correctly reproducing the conditions of the scenarios selected to track testing.	
7.3.2.3.1.2. The assessor shall verify that the manufacturer has suitable processes in place to identify test routes that capture predictable aspects of the ODD (e.g., road types and geometries), elements found in the related nominal situations (e.g., other road users, signs, and signals), and typical dynamic conditions (e.g., high/low traffic densities). The test routes shall also enable verification of requirements for the safety of user interactions, including prior to, at the time of, and after entering and exiting the ODD of an ADS feature.	
7.3.2.3.2. The assessor shall verify that the manufacturer has suitable processes, resources and competent personnel to undertake the testing that produces the evidence supporting the ADS safety case.	
7.3.2.3.2.1.The assessor shall verify that the manufacturer has suitable processes, resources and competent personnel to assess the behavioural competencies demonstrated by the ADS for each [scenario and situation], against the performance requirements of the Dynamic Driving Task (DDT).	
7.3.2.3.2.2. The assessor shall verify that the manufacturer has suitable processes, resources and competent personnel who can assess the capability of the ADS to ensure the safety of users and the safe use of the ADS.	
7.3.2.3.3. The assessor shall verify that the manufacturer has not optimised the ADS for a set of known test cases.	
7.3.2.4. Assessment of testing evidence	
7.3.2.4.1. The assessor shall review the evidence produced by the manufacturer in demonstrating the ADS safety case using the different testing methods:	
a) Virtual testing	
b) Track testing	
c) Real world testing	
7.3.2.4.1.1. The assessor shall review the evidence produced by the manufacturer in demonstrating the capability of the ADS to perform its Dynamic Driving Tasks (DDT).	
7.3.2.4.1.2. The assessor shall review the evidence produced by the manufacturer in demonstrating the capability of the ADS to interact safely with users in line with the provisions laid down in 5.2.	
7.3.2.4.1.4. The assessor shall verify that the procedures and data collection associated with testing are in line with established scientific and engineering practice.	

UN GTR	UN Regulation
7.3.2.4.1.5.　　　For the specific case of ADS interaction testing, the assessor shall:	
a)　Verify that the people involved are representative of the expected general population of ADS users and other road users where applicable;	
b)　Verify that the results achieved can be considered statistically significant.	
7.3.2.4.1.6.　　　The assessor shall verify the suitability of the set of tests carried out as evidence to support the safety case, in particular in terms of coverage, consistency, and relevance.	
7.3.2.4.1.7.　　　The assessor shall verify that the results of the tests are able to demonstrate the behavioural competencies of the ADS when performing the DDT. In particular the assessor shall verify that the test results confirm the claims and arguments in the ADS safety case:	
a)　in nominal, critical and failure situations;	
b)　while approaching and crossing the ODD boundaries;	
c)　in the case that collisions with other road users are not deemed to be preventable	
7.3.2.4.1.8.　　　The assessor shall verify that the manufacturer has suitable processes in place to identify the set of scenarios to be tested using the different testing methods.	
7.3.2.4.1.9.　　　The assessor shall verify that the manufacturer has suitable processes in place to verify the consistency of the test results across the different testing methods adopted.	
7.3.2.4.2.　　　Assessment of virtual testing evidence.	
7.3.2.4.2.1.　　　The assessor shall verify that the manufacturer's virtual testing has been carried out incorporating proper consideration of the assumptions, accuracy and uncertainty in the simulation toolchain(s) in line with the requirements laid down in 6.2.2. The reviewer shall verify that the use of the results from the virtual testing reflects these considerations.	
7.3.2.4.2.2.　　　The assessor shall verify that any virtual test using simulation toolchain(s) containing stochastic elements has taken account of the possible uncertainty in the results.	
7.3.2.4.2.3.　　　If the manufacturer is using virtual testing to demonstrate scenario coverage the assessor shall verify that they have included critical scenarios and low probability events. The critical scenarios shall include unavoidable collision scenarios.	
7.3.2.4.3.　　　　Assessment of track testing evidence.	
7.3.2.4.3.1　　　The assessor shall review the evidence from track-testing that is provided by the manufacturer to support the ADS' safety case.	

UN GTR	UN Regulation
7.3.2.4.3.2 The assessor shall verify that at least part of the scenario tested via track-testing includes critical scenarios replicating conditions that could result in a collision.	
7.3.2.4.4. Assessment of real-world testing evidence.	
7.3.2.4.4.1. The assessor shall review the evidence from real world testing that is provided by the manufacturer to support the ADS safety case.	
7.3.2.4.4.2. The assessor shall verify that the evidence collected via real world testing by the manufacturer covers a wide variety of situations and conditions that the ADS may encounter during its real-world operations.	
7.3.2.4.4.3. To the extent that an ADS encounters critical or failure situations during a real-world test drive, the response of the ADS, including any discrepancies with the nominal performance requirements, shall be considered by the assessor in conjunction with the outcomes of track and virtual testing.	
7.3.3. Confirmatory testing	
7.3.3.1. Confirmatory testing conducted or required by an independent assessor shall use one or more testing methods and pre-defined and repeatable test protocols to confirm that the evidence provided by the manufacturer accurately represents the ADS performance. The test protocols shall cover a range of driving conditions representative of the Operational Design Domain (ODD)	
7.3.3.1.1. This should include at least and as appropriate[49]:	
a) Failure situations	
b) Behaviours in the presence of vulnerable road users	
c) Situations with a large number of other road users, unlikely road infrastructure, or abnormal geographic/environmental conditions	
d) User interactions	
e) Traffic rule compliance	
f) Collision avoidance and mitigation	
g) ODD boundaries and fallback to MRC	
h) DSSAD and ISMR capabilities	

---

[49] The information reported in the Annex [XX – DDT Annex] may be used to extend the list of scenarios that can be selected for confirmatory testing.

UN GTR	UN Regulation
7.3.3.1.2.　　　The assessor shall ensure that the physical testing (proving ground and/or public road) facilities and environment and the virtual testing environment as applicable are suitable to conduct the testing and confirm the evidence provided by the manufacturer to support the safety case in line with the provisions laid down in 7.2. and sub-paragraphs.	
7.3.3.1.3.　　　The assessor shall compare the information generated by the confirmatory testing with the evidence produced by the manufacturer to check that there is an appropriate level of consistency between them.	
7.3.3.1.4.　　　The assessor's confirmatory testing strategy may identify a test case that is within the ODD but not easily compared to an existing result provided by the manufacture. This case should still be considered and the results compared with the manufacturer's expected behaviour. The expected behaviour should be determined in discussion with the manufacturer.	
7.3.3.1.2.1.　　　If the assessor is unable to confirm that there is an appropriate level of consistency between the results, the manufacturer shall review the alleged discrepancies and take appropriate action to resolve them.	
7.3.3.2.　Virtual testing	
[7.3.3.2.1.　　　The assessor may conduct or require virtual testing to confirm the evidence submitted by the manufacturer performance of the ADS in a number of selected relevant nominal, critical, and failure scenarios.]	
7.3.3.2.1.1.　　　The provisions included in the following paragraphs until 7.3.3.2. apply in the case that confirmatory virtual testing are conducted or required.	
7.3.3.2.1.2.　　　The assessor shall demonstrate that the simulation toolchain used for virtual testing complies with the requirements laid down in 6.2.1.	
7.3.3.2.1.3.　　　The assessor shall document their choices for the scenarios selected.	
7.3.3.2.2.　　　The assessor may request to use the virtual testing environment used by the manufacturer to carry out confirmatory virtual testing.	
7.3.3.3.　Track testing	
[7.3.3.3.1.　　　The assessor shall conduct or require the use of track testing to confirm the performance of the ADS in a number of selected relevant nominal, critical, and failure scenarios, unless the assessor deems that these scenarios can be sufficiently covered through real-world confirmatory testing.]	
7.3.3.3.1.1.　　　The provisions included in the following paragraphs until 7.3.3.4. apply in the case that confirmatory track testing are conducted or required.	
7.3.3.3.1.2.　　　The assessor shall explain and document their choices for the scenarios used to test the ADS.	
7.3.3.3.2.　　　Any track testing shall be conducted on a testing ground that is part of, or suitably represents, the ODD of the ADS and complies with the requirements laid down in 6.2.2.	

UN GTR	UN Regulation
7.3.3.3.2.1. The assessor may request to use the testing ground used by the manufacturer to carry out confirmatory track testing.	
7.3.3.3.3. Track testing may be conducted to verify that ADS responds safely to situations:	
a) occurring within the ODD;	
b) occurring while crossing the ODD boundaries;	
c) concerning its activation outside of the ODD.	
7.3.3.3.4. The assessor shall consider how to manage real world variations. Variations may include, but are not limited to, changes in lighting conditions, weather, road surface conditions, and surrounding traffic behaviour. The assessor shall confirm that the ADS maintain safe performance within its ODD and verify that the ADS responds to approaching and crossing of ODD boundaries in line with the safety case.	
7.3.3.3.5. The assessor shall ensure an appropriate protocol is used for recording the track testing. It will contain at least minimum requirements on test relevant data collection and analysis, e.g., how the data is recorded, how measurements are derived from the recorded data, and how the measurements are analysed.	
7.3.3.3.6. The assessor shall ensure that the track testing carried out is recorded with sufficient details to allow the tests to be reproduced to a sufficient level of accuracy. The information recorded shall include at least the test equipment, the test set-up, and the test environment, as well as any variations and adjustments	
7.3.3.3.7. The assessor shall select scenarios where the behaviour or position of other road users require the ADS to react to their movement or presence.	
7.3.3.3.8. The assessor shall use track testing to also confirm that user(s)-related aspects are in line with the ADS safety case.	
7.3.3.4. Real world testing	
[7.3.3.4.1. ~~The assessor shall conduct or require real world testing of the ADS in nominal scenarios. It is acknowledged that critical and/or failure scenarios may occur during real world testing, but generally should not be tested on purpose. If such scenarios occur, they shall not be excluded from the assessment.~~]	
7.3.3.4.2. The assessor shall ensure that real world testing is conducted safely and therefore can end a test at any point if it becomes unsafe.	
7.3.3.4.3. The assessor shall ensure that real world testing only be conducted if an appropriate level of safety for the other road users and for users in the vehicle can be demonstrated.	
7.3.3.4.4. The assessor shall demonstrate that real world testing confirms the claimed ADS performance in real traffic conditions.	

UN GTR	UN Regulation
7.3.3.4.5. The assessor shall demonstrate that real-world testing confirms the claimed ADS performance when approaching and crossing ODD boundaries, where appropriate.	
7.3.3.4.6. The assessor shall demonstrate that real world testing confirms the claimed ADS performance relating to issues that may not be well captured by track tests and simulation, such as perception quality limitation (e.g. due to light and environmental conditions, etc.).	
7.3.3.4.7. The assessor shall demonstrate that real world testing confirms the claimed ADS performance for aspects relating to human factors, such as user-initiated deactivation, system-initiated deactivation (not leading to a [mitigated] risk condition), audibility of messages in real world conditions, if applicable to the ADS.	
7.3.3.4.8. The assessor shall demonstrate that real world testing confirms the claimed ADS performance related to the interaction with ADS users and other road users under these conditions.	
7.3.3.4.9. The assessor shall review the environment and conditions of the selected test routes to ensure they reflect the environment and conditions of the ADS' ODD.	
7.3.3.4.10. The assessor shall ensure that the selection of test routes utilizes appropriate strategies to enhance the probability of ADS encountering situations that involve a large number of other road users, unlikely road infrastructure, or abnormal geographic/environmental conditions, by examining when and where specific elements (e.g. high- or low-density traffic) typically occur. It is understood that it may not be possible to encounter all traffic situations during a real world test.	
7.3.3.4.10. The assessor shall ensure that an appropriate protocol is followed when undertaking real world testing. It should contain minimum requirements that standardise how the test relevant data are to be collected and analysed (e.g., how the data is recorded, how measurements are derived from the recorded data, and how the measurements are analysed).	
7.3.3.4.11. The assessor shall ensure that real world testing confirms the claimed ADS performance both within its ODD and outside its ODD (e.g. to determine the ADS's appropriate recognition and response when not in its ODD) on public roads.	
7.3.3.4.12. The assessor shall review any infractions identified during real world testing and assess it both directly and by evaluating it against any other relevant and available evidence, e.g. the data gathered during other testing or supplied by the manufacturer.	
7.3.3.4.13. In case of track testing according to 7.3.3.2., the assessor shall compare the information generated during real world testing with the information from track testing to ensure there is the appropriate level of correlation of the results including the ADS' performance.	
7.3.3.4.13.1. If there is insufficient consistency between the results then the manufacturer should be informed and should review the alleged discrepancies and take appropriate action to resolve them.	
7.3.3.4.14. Test coverage and termination criteria	
7.3.3.4.14.1. The real-world test drive shall cover the functions required to perform the entire DDT in the ODD pursuant to the outcomes of the safety case analysis.	

UN GTR	UN Regulation
7.3.3.4.14.2. The test should be terminated only when all relevant parts of 7.3.3.4.14.1, excluding safety critical and failure related scenarios, have been monitored and assessed.	
7.4. Post-Deployment Safety Assessment	
7.4.1. The assessment shall review the information provided by the manufacturer and assess that it is in accordance with the manufacturer's SMS	7.4.1. The approval authority or its designated technical service shall receive information provided by the manufacturer and assess that it is in accordance with the manufacturer's SMS
7.4.2. The information provided by the manufacturer on the ADS operations (e.g. Notification, short term and periodic reports) shall be reviewed:	7.4.2. The approval authority or its designated technical service shall review the information provided by the manufacturer on the ADS operations (e.g. Notification, short term and periodic reports):
(a) To receive confirmatory evidence on the safety case and on the Safety Management System,	
(b) To receive information on the ADS safety level and assess whether the ADS continues to be safe when operated on the road,	
(c) If applicable, to verify that this information, is used to develop new scenarios or variations of existing scenarios included in the Safety case' evidence, and	
(d) To ensure the effectiveness of the implemented corrective actions.	
7.4.3. The Assessor shall review the manufacturer's data processing (for example: filtering and conditioning) procedure during occurrence investigation and agree on the steps undertaken to deliver the data supporting the report.	7.4.3. The approval authority or its designated technical service shall review the manufacturer's data processing (for example: filtering and conditioning) procedure during occurrence investigation and agree on the steps undertaken to deliver the data supporting the report.
7.4.4. The confidentiality of sensitive and business confidential information reported in accordance with the short-term template shall be assured.	7.4.4. The approval authority or its designated technical service shall ensure the confidentiality of sensitive and business confidential reported information in the short-term template.
7.4.5. The Assessor, where necessary, may verify the information provided and, if needed, the assessor may require further investigations and evidence, including test, before closing the occurrence.	7.4.5. The approval authority or its designated technical service, where necessary, may verify the information provided and, if needed, the approval authority or its designated technical service may require further investigations and evidence, including test, before closing the occurrence.

UN GTR	UN Regulation
	7. Modifications and extension of approval of the vehicle type
	7.1. Every modification of the vehicle type with regard to this Regulation shall be notified to the Type Approval Authority which approved that vehicle type. The Type Approval Authority may then either: (a) Decide, in consultation with the manufacturer, that a new type approval is to be granted; or (b) Apply the procedure contained in paragraph 7.1.1. (Revision) and, if applicable, the procedure contained in paragraph 7.1.2. (Extension).

	7.1.1. Revision
	     When particulars recorded in the information documents of Annex 1 - Appendix 1 have changed and the Type Approval Authority considers that the modifications made are unlikely to have appreciable adverse effect, and that in any case the vehicle still meets the requirements, the modification shall be designated a "revision".
	     In such a case, the Type Approval Authority shall issue the revised pages of the information documents of Annex 1 - Appendix 1 as necessary, marking each revised page to show clearly the nature of the modification and the date of re-issue. A consolidated, updated version of the information documents of Annex 1 - Appendix 1, accompanied by a detailed description of the modification, shall be deemed to meet this requirement.

	7.1.2.Extension The modification shall be designated an "extension" if, in addition to the change of the particulars recorded in the information folder: (a) Further inspections or tests are required; or (b) Any information on the communication document (with the exception of its attachments) has changed; or (c) Approval to a later series of amendments is requested after its entry into force.
	7.2. Notice of confirmation, extension, or refusal of approval shall be communicated by the procedure specified in paragraph 4.3. above, to the Contracting Parties to the Agreement applying this Regulation. In addition, the index to the information documents and to the test reports, attached to the communication document of Annex 1, shall be amended accordingly to show the date of the most recent revision or extension.
	7.3. The Type Approval Authority issuing the extension of approval shall assign a series number to each communication form drawn up for such an extension.

UN GTR	UN Regulation
	8. Conformity of Production The conformity of production procedures shall comply with those set out in the Agreement, Schedule 1 (E/ECE/TRANS/505/Rev.3), with the following requirements:
	8.1. Every vehicle bearing approved under this Regulation shall conform to the vehicle type approved by meeting the requirements set out in paragraph 5. above.
	9. Penalties for non-conformity of production
	9.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8.1. above is not complied with.
	9.2. If a Contracting Party to the Agreement which applies this Regulation withdraws an approval it has previously granted, it shall forthwith notify the other Contracting Parties applying this Regulation by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation "APPROVAL WITHDRAWN".
	10. Production definitively discontinued If the holder of the approval completely ceases to manufacture the vehicle type approved in accordance with this Regulation, he shall so inform the Type Approval Authority which granted the approval. Upon receiving the relevant communication that Type Approval Authority shall inform thereof the other Contracting Parties applying this Regulation by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation "PRODUCTION DISCONTINUED".
	11. Names and addresses of Technical Services responsible for conducting approval tests and of Type Approval Authorities The Contracting Parties to the Agreement applying this Regulation shall communicate to the Secretariat of the United Nations the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to which forms certifying approval or refusal, or extension or withdrawal of approval, issued in the other countries, are to be sent.

UN GTR	UN Regulation
Annexes	
	Annex 1. Communication
	Annex 2. Examples of arrangements of approval marks

Annex 1.   List of Reportable Occurrences by Reporting Type

Annex 3.   List of Reportable Occurrences by Reporting Type

The following table lists the occurrences to be reported by the manufacturer in accordance with para. 6.4. of this Regulation. The table indicates the reporting type(s) that apply to each occurrence.

Occurrences	Reporting Type		
	Notification	Short-term	Periodic
1. **Critical occurrences**[1]	X	X	X
2. **Significant occurrences**			
ADS operation outside its ODD		X	X
ADS failure to achieve a [mitigated] risk condition when necessary		X	X
Failure to meet the ADS requirements as per the Section 5 of this regulation		X	X
Performance issues constituting an unreasonable risk to safety		X	X
3. **Other occurrences**[2]			
Uncompleted system-initiated deactivation processes to manual driving			X
Communication issues affecting the safety of the ADS			X
Cybersecurity issues affecting the safety of the ADS			X
System failures that compromise the capability of the ADS to perform the entire DDT			X
Maintenance or repair issues affecting the ADS's intended functionality [3]			X
Unauthorized modifications to ADS that could affect the intended functionality			X
Manoeuvres performed to reach MRC			X

Emergency Manoeuvres			X
Active ADS feature required remote interaction to navigate a driving situation [4]			X
Fallback user unavailability [5]			X
Prevention of takeover under unsafe conditions[6]			X

[1] If such an occurrence also belongs to one of the remaining sub-categories listed in the occurrence table, the following provisions apply:

- Short-term report: there is no need to double-report such occurrence also as part of one of the remaining categories listed in the table.

- Periodic reporting: the occurrence should be double reported both as part of critical occurrence and as occurrence belonging to one of the remaining categories listed in the table. However, the report shall specifically note this aspect.

[2] The Occurrences of this category could be also reported as critical or significant occurrences. In this case, the periodic report shall specifically note this aspect.

[3] This occurrence captures systematic problems due to a maintenance/repair/service action discovered during the ADS operations.

[4] This occurrence captures events in which the ADS will require a support for "tactical functions" to cope with very specific situations, while the ADS continues to perform the entire dynamic driving task.

[5] At aggregate level, this information can provide useful information on the validity of the HMI concept and on the need to provide more effective procedures for keeping the fall-back user available.

[6] It is acknowledged that there is no obligation to implement such design solution. However, such information can provide useful information to evaluate the safety benefit of implementing such solution.

UN GTR	UN Regulation
0.1 The Annexes [2] and [3] list two reporting templates aimed at assuring the harmonization of the information to be reported by the manufacturer to the relevant authority.	0.1 The Annexes [4] and [5] list two reporting templates aimed at assuring the harmonization of the information to be reported by the manufacturer to the relevant authority.
0.2 The data elements marked as mandatory represent information available to the manufacturers or that the manufacturer is expected to retrieve within either 30 days (short-term reporting) or on a yearly basis (periodic reporting). Such information shall be reported as part of the mandatory reporting requirements in Annex 2 and 3.	0.2 The data elements marked as mandatory represent information available to the manufacturers or that the manufacturer is expected to retrieve within either 30 days (short-term reporting) or on a yearly basis (periodic reporting). Such information shall be reported as part of the mandatory reporting requirements in Annex 4 and 5.
0.3 The non-mandatory data elements should be reported if the manufacturer has the relevant information.	
0.4 It is advised that non-mandatory data elements are made available to the relevant authority via collaboration with third-party stakeholders, however there is no obligation to do this.	
Annex 2. In-Service Reporting Template: Short-term Reporting	Annex 4. In-Service Reporting Template: Short-term Reporting
1.1. The following template aims at ensuring that a consistent and comprehensive set of information is delivered to the relevant authority to foster an effective implementation of the short-term reporting ISMR requirements.	
1.2. The manufacturer may use the short-term template to also report for other occurrences which are not mandated in **Annex 1.**	1.2. The manufacturer may use the short-term template to also report for other occurrences which are not mandated in **Annex 3.**
1.3. Depending on the nature of the significant occurrence, non-applicable fields shall be marked N/A.	
1.4. The authority may request further information where a field has been marked N/A.	

WHAT			
Entry name	*Mandatory [Y/N]*	*Field to be filled*	*Type/size*
Headline	Y		Text
OCCURRENCE CLASSIFICATION			
Occurrence class[50]	Y		Text
Occurrence type[51]	Y		Text
OCCURRENCE DETAILS			
Last active / active ADS feature at the time of the occurrence	Y		Text
ODD conditions relevant to the occurrence analysis	Y		Text
Maximum ADS-determined/estimated vehicle speed [10] seconds prior to the collision	Y		Number – [km/h]
Maximum ADS vehicle longitudinal deceleration [10] seconds after the collision	Y		Number– [m/s^2]
Availability of EDR data	Y		[Y/N]
Availability of DSSAD data	Y		[Y/N]
Additional supporting data available[52]	Y		[Y/N]
Occurrence reported to the law enforcement known to the manufacturer	N		[Y/N]
Police report available	N		[Y/N]
VEHICLE DETAILS			
Vehicle Identification Number	Y		Text(17)
Vehicle approval number	Y		Text
Vehicle category	Y		Text
Mileage	N		Number
ADS identifier	Y		Text

---

[50] Class can be: critical occurrence/significant occurrence/other occurrence.

[51] Ref Table Annex I.

[52] Data can include ADS vehicle data (speeds…), ADS vehicle collected media (cameras…) or third-party sources.

ADS licensing authorities	N		Text
Operator (if any/available)	N		Text
Other ADS features	N		Text

WHEN			
UTC date	Y		[YYYY/MM/DD]
UTC time	Y		[HH:mm]
Local date	Y		[YYYY/MM/DD]
Local time	Y		[HH:mm]

WHERE			
Country	Y		Text
State/Province	N		Text
City	N		Text
GNSS coordinates	Y		[longitude, latitude] [Decimal degree]
Roadway type	Y		Text
Roadway surface	Y		Text
Roadway description	Y		Text

KNOWN/ALLEGED DAMAGE

Description of Damage to the ADS vehicle	N					Text

ADS vehicle damage area(s)	N					
		Front left []	Front centre []	Front right []	Top []	
		Rear left []	Rear centre []	Rear right []	Bottom []	
		Right side []	Left side []	Unknown []		

ADS vehicle occupant restraint systems deployed	N		[Y/N]
ADS vehicle towed	N		[Y/N]
Any ADS features no longer able to operate	N		[Y/N]
Other vehicles damaged	N		[Y/N]
KNOWN/ALLEGED INFRASTRUCTURE DAMAGE			
Infrastructure type	N		Text
Detailed description	N		Text
KNOWN/ALLEGED INJURY[53]			
Injury type	N		[Fatal/non-fatal]
No. of Fatalities to ADS users	N		Number
No. of Fatalities to ADS other road users	N		Number
Injury type to ADS users	N		[No./TEXT]
Injury type to other road users	N		[No./TEXT]
DESCRIPTION OF THE OCCURRENCE			
Detailed description[54]	Y		Text
Post-occurrence behaviour	Y		Text
ANALYSIS			
Root cause analysis	Y		Text
Corrective action needed	Y		[Y/N]
Corrective action implemented	Y		[Y/N]

UN GTR			UN Regulation
If implemented, description of corrective action	*Y*		Text
New/Variation of existing scenario encountered	*Y*		[Y/N]
Speed limit at location	*Y*		Number
ADS user(s) available at occurrence, in case of ADSF-1 [Y/N]	*N*		[Y/N]
Attempted (successful/completed) user-initiated deactivation of the ADS feature within 30 seconds prior to the occurrence, if applicable [Y/N].	*N*		[Y/N]
REPORT MANAGEMENT			
Reporting entity	*Y*		Text
Report ID	*Y*		Text
Report version	*Y*		Number
Report status (e.g., initial notification, in progress, closed)	*Y*		Text
Report date	*Y*		[YYYY/MM/DD]
Parties informed	*Y*		Text

---

[53] Supporting information can be derived from CADaS taxonomy (https://road-safety.transport.ec.europa.eu/system/files/2021-07/cadas_glossary_v_3_7.pdf) or from Abbreviated Injury Scale (https://www.aaam.org/abbreviated-injury-scale-ais/)
[54] If the ADS did not deviate from its intended functionality or violate safety requirements, the field can provide supporting justification. Otherwise, the root cause analysis will identify and explain the issue.

UN GTR	UN Regulation
Annex 3. In-Service Reporting Template: Periodic Reporting	Annex 5. In-Service Reporting Template: Periodic Reporting
1.1. The periodic template provides a list of information with their corresponding reporting specifications that should be made available to the authority on a yearly basis.	
1.2. The following template aims at ensuring that a consistent and comprehensive set of information is delivered to the relevant authority to foster an effective application of the periodic reporting scheme. Further granularity of the information can be considered depending on the ADS use cases	
1.3. Where an ADS has more than one feature, the periodic report shall clearly differentiate each feature	

ADS IDENTIFICATION

Entry name	Mandatory [Y/N]	Field to be filled	Type/size
Manufacturer	Y		Text
Vehicle/system approval number	Y		
ADS licensing authority(ies) (if applicable)	N		Text
ADS software version/identifier(s)	Y		Text
Applicable SMS	Y		Text
Number of ADS-equipped vehicles	Y		Number

ADS OPERATION INFORMATION (segmented by ADS feature)

Entry name	Mandatory [Y/N]	Field to be filled	Type/size
Number of ADS-equipped vehicles per feature	Y		Number
Cumulative distance travelled by an active ADS feature, optionally segmented by	Y		Number
• Country/province of operation	N		Text
• Times of the day	N		Text
• Weather conditions	N		Text
• Road conditions[55]	N		Text
Cumulative time travelled by an active ADS feature, optionally segmented by	Y		Number
• Country/province of operation	N		Text
• Times of the day	N		Text
• Weather conditions	N		Text
• Road conditions	N		Text

---

[55] Those refer to the state of the road at the time of operation, such as: dry, wet, icy, snowy, or muddy.

Average ADS time engagement	*Y*		Number
OCCURRENCES ASSESSMENT (segmented by ADS feature)			
Occurrences covered under the short-term reporting provisions			Number
• Critical occurrences known to the manufacturer	*Y*		Number
• ADS operation outside its ODD	*Y*		Number
• ADS failure to achieve an MRC when necessary	*Y*		Number
• Failure to meet requirements as per the Section 5 of this Regulation	*Y*		Number
• Performance issues constituting an unreasonable risk to safety	*Y*		Number
Occurrences covered under the periodic reporting provisions			
• Uncompleted system-initiated deactivation process to manual driving	*Y*		Number
o Occurrences safety review	*Y*		Text
• Communication issues affecting the safety of the ADS	*Y*		Number
o Occurrences safety review	*Y*		Text
• Cybersecurity issues affecting the safety of the ADS	*Y*		Number
o Occurrences safety review	*Y*		Text
• System failures that compromise the capability of	*Y*		Number

the ADS to perform the entire DDT			
o Occurrences safety review	Y		Text
• Unauthorized modifications to the ADS that could affect the intended functionality	Y		Number
o Occurrences safety review	Y		Text
• Manoeuvres performed to reach MRC	Y		Number
o Occurrences safety review	Y		Text
• Emergency Manoeuvres	Y		Number
o Occurrences safety review	Y		Text
• ADS feature required remote interaction	Y		Number
o Occurrences safety review	Y		Text
• Fallback user unavailability (where applicable)	Y		Number
o Occurrences safety review	Y		Text
• Prevention of takeover under unsafe conditions (where applicable)	Y		Number
o Occurrences safety review	Y		Text
OCCURRENCES SAFETY OUTCOME (segmented by ADS feature)			
Fatalities	Y		Number
• ADS vehicle users	Y		Number
• Other road users	Y		Number

Injuries	*Y*		Number/Text
• ADS vehicle users	*Y*		Number/Text
• Other road users	*Y*		Number/Text
Total number of detected collisions	*Y*		Number
• Collision review	*N*		Text
OCCURRENCES AGGREGATE DESCRIPTION (segmented by ADS feature)			
Collision with[56]:	*Y*		-
• Passenger car	*N*		Number
• VAN	*N*		Number
• Truck	*N*		Number
• Bus	*N*		Number
• Other: Vehicle	*N*		Number
• Motorcycle	*N*		Number
• Cyclist	*N*		Number
• Pedestrian	*N*		Number
• Other: VRU	*N*		Number
• Animal	*N*		Number
• Fixed object	*N*		Number
• Unknown	*N*		Number
ADS vehicle damage level			-
• ADS vehicle no longer able to operate	*Y*		Number
• ADS vehicle needing repairs	*Y*		Number
• Unknown	*Y*		Number
ADS vehicle damaged area			-

---

[56] The following list is provided as an example, manufacturers may use different categories as long as "vehicle" and "vulnerable road-users" are reported separately.

• Front	*Y*		Number
• Front-left	*Y*		Number
• Front-right	*Y*		Number
• Rear	*Y*		Number
• Rear-left	*Y*		Number
• Rear-right	*Y*		Number
• Left	*Y*		Number
• Right	*Y*		Number
• Top	*Y*		Number
• Bottom	*Y*		Number
• Unknown	*Y*		Number
ADS MONITORING ASSESSMENT (segmented by ADS feature)			
ADS Safety Monitoring manufacturer outcome, including:	*Y*		Text
• SPIs monitoring analysis	*Y*		Text
• Identified operational risks	*Y*		Text
• Identified corrective actions	*Y*		Text
• Implemented corrective actions	*Y*		Text
REPORT MANAGEMENT			
Reporting entity	*Y*		Text
Report ID	*Y*		Text
Report version	*Y*		Number
Report status (e.g., initial notification, in progress, closed)	*Y*		Text
Report date	*Y*		[YYYY/MM/DD]
Parties informed	*Y*		Text

UN GTR		UN Regulation	
Annex 4.	Definition of Thresholds for Critical Occurrences	Annex 6.	Definition of Thresholds for Critical Occurrences
1.	General		
1.1.	This annex defines thresholds for the reporting of critical occurrences as defined under paragraph 3.13.1.		
1.2.	The timing for the notification of such occurrences starts from the manufacturer's knowledge that the occurrence exceeded the threshold for critical occurrence.		
1.3.	The manufacturer shall exert all reasonable efforts to gather the relevant evidence supporting the critical occurrence identification without delays or limitations.		
2.	Injury level threshold		
2.1.	The injury level threshold for a critical occurrence aims at promoting the reporting of collisions resulting in a fatality or any person requiring medical attention due to the injury, regardless of whether the person killed or injured was an occupant of the subject vehicle.		
2.2.	The threshold is triggered by the attendance in the area of the collision of an ambulance.		
2.3.	The manufacturer shall classify the occurrence as critical if they reasonably believe that there may be an injury requiring medical attention to any person even if an ambulance has not been detected.		
2.4.	The manufacturer is expected to fulfil these criteria through one of the following approaches:		
	(a) ADS strategies in place to appropriately detect such situations provided that the ADS vehicle is still capable of performing audio/visual sensing capabilities, following the collision or via remote visual check (if applicable);		
	(b) Processes to receive and analyse information from other sources;		
	(c) Combination of (a) and (b).		
3.	Physical damage threshold		
3.1.	The physical damage triggering condition for critical occurrence aims at promoting the reporting of collisions that, despite not causing any significant injury or fatality to people, are deemed critical because of the extent of the damages produced on vehicles or stationary objects.		
3.2.	The concept of "physical damage" is here intended as:		
	(a) Tow-away, e.g., damage that restricts/prevents regular operation of a vehicle involved in the collision as part of the reported occurrence;		

	(b)	Importance-based, e.g., a damage that affects the safe state of the ADS, critical road infrastructure asset and other vehicles/road users;
3.3.		The manufacturer is expected to fulfil this criterion through one of the following approaches:
	(a)	ADS strategies in place to appropriately detect such situations provided that the ADS vehicle is still capable of performing audio/visual sensing capabilities, following the collision or via remote visual check (if applicable);
	(b)	Processes to receive and analyse information from other sources;
	(c)	Combination of (a) and (b).
3.4.		Tow-away damage threshold
3.4.1.		The tow-away threshold is triggered when the damage occurred to a vehicle involved in the collision is such that the same can no longer be operated either manually or in automated mode requiring specialized equipment for traffic restoration.
3.5.		Importance-based damage threshold
3.5.1.		Importance-based damage thresholds consider the type of the item which was damaged to take into account their relevance and health status.
3.5.2.		The importance-based threshold shall be deemed exceeded when one of the following conditions occurs:
	(a)	Collision with priority vehicles,
	(b)	Collision rendering traffic lights and/or other safety-relevant road signage no longer operational/visible,
	(c)	Collision affecting infrastructure communication/connectivity support system,
	(d)	Collision damaging or rendering a roadway segment impassable,
	(e)	Collision producing fire, or
	(f)	Any other collision which requires the attendance of road safety agent.
4.		Restraint system and Delta-V threshold
4.1.		The restraint system triggering condition and Delta-V threshold aims at promoting the reporting of occurrences in case one of the following applies:
	(a)	the deployment of any non-reversible deployable occupant restraint systems,
	(b)	the deployment of vulnerable road user secondary safety system, such as airbags, pretensions, and active bonnet systems, or
	(c)	the applicable Delta-V thresholds to be met according to the EDR system fitted on the vehicle.

UN GTR		UN Regulation	
Annex 5.	ODD-based Behavioural Competencies and Scenario Identification Approach	Annex 7.	ODD-based Behavioural Competencies and Scenario Identification Approach
1.	Introduction		
This annex provides an overview on an approach that may be used to derive verifiable performance criteria for the approval or, as relevant, for self-certification of ADS, based on the manufacturer's description of the Operational Design Domain (ODD) of the ADS. Such criteria would be developed by identifying behavioural competencies that embody and correspond to specific ADS safety requirements and relevant [scenarios and situations] that may be used to validate the ADS's competencies.			
	The suggested approach includes a description of how such competencies can be classified into nominal, critical and failure and mapped to the relevant [scenarios and situations], selected either from existing databases or identified through the application of different approaches.		
	Different approaches may exist to perform such an activity; therefore, the approach herein presented should be considered as a recommended guideline for both manufacturers and authorities.		
1.1.	Operational Design Domain		
	The external conditions constituting the ODD in which the ADS was designed to operate will help determine which ADS competencies are required. For example, if an ADS has an ODD which comprises of roads with non-signalised junctions, one of the required behavioural competencies for the ADS in that ODD could potentially be "unprotected left or right turn". However, the same behaviour competency may not be required if the ODD of an ADS is limited to motorways or highways.		
1.2.	Behavioural competencies		
	Behavioural competencies track the three broad categories of driving situations that may be encountered in the performance of the DDT: nominal, critical, and failure.		
	[Nominal driving situations are those in which behaviour of other road users and the operating conditions of the given ODD are reasonably foreseeable (e.g., other traffic participants operating in line with traffic regulations) and no failures occur that are relevant to the ADS's performance of the DDT.]		
	[Critical driving situations are those in which the behaviour of one or more road users (e.g., violating traffic regulations) and/or a sudden and not reasonably foreseeable change of the operating conditions of the given ODD (e.g., sudden storm, damaged road infrastructure) creates a situation that requires a prompt action of the ADS to avoid or mitigate a collision. In this case, it is recognised that the ADS may not be able to avoid a collision, but mitigation may be possible.]		
	[Failure situations involve those in which the ADS or another vehicle system experiences a fault or failure that compromises the ADS's ability to perform the DDT, such as sensor or computer failure or a failed propulsion system.]		
2.	Approach Description		

The ODD-based behavioural competencies and scenario identification approach is based on the interaction of the following elements:

(a) Behavioural competencies and scenario generation

(b) Competencies and scenario mapping

(c) Assumptions

(d) Performance and acceptance criteria evaluation

Figure 2 describes the overall approach. Once acceptance criteria are defined based on overall requirements, different approaches (described below) are used to generate nominal, critical and failure scenarios tests. Testing is performed using various test methods, and the outcome is evaluated to see if there is sufficient evidence to support the safety case claims and the acceptance criteria. The following section describes the different stages and steps.

| 2.1. | Behavioural Competencies Identification |

The approach suggests a series of analytical frameworks that could help to derive measurable criteria appropriate for the specific application. These frameworks are divided into:

(a) ODD Analysis

(b) Driving interactions analysis

(c) OEDR analysis

| 2.1.1. | ODD analysis |

This analysis represents the first step with the aim to identify the characteristics of the ODD. An ODD [specification/description] may consist of stationary physical elements (e.g., physical infrastructure), environmental conditions, dynamic elements (e.g., reasonably expected traffic level and composition, vulnerable road users) and operational constraints to the specific ADS application. Various sources provide useful guidance for precisely determining the elements of a particular ODD and their format definition.[57,58, 59, 60]

| 2.1.2. | Driving interactions analysis |

In the driving interactions analysis, the behaviours of other road users that are reasonably expected and the presence of roadway characteristics in the ODD are explored in more detail by mapping actors with appropriate properties and defining interactions between the objects.

---

[57] *AVSC Best Practice for Describing an Operational Design Domain: Conceptual Framework and Lexicon*; and *A Framework for Automated Driving System Testable Cases and Scenarios* (NHTSA).

[58] BSI PAS 1883:2020 Operational Design Domain (ODD) taxonomy for an automated driving system (ADS) - Specification

[59] ASAM OpenODD

[60] ISO 34503 - Road Vehicles — Test scenarios for automated driving systems — Taxonomy for operational design domain

	An example of this analysis is given in Table 1, where static and dynamic behaviours of other objects (including other road users) that the ADS is reasonably expected to encounter within the ODD are described. In the case of vehicles, this includes behaviours such as "acceleration", "deceleration", "cut-in"; for pedestrians, examples of dynamic behaviours include "crossing road", "walking on sidewalk", etc.
	The behaviour of other road users and the condition of physical objects within the ODD may fall at any point along a continuum of likelihood. For example, deceleration by other vehicles may range from what is expected and reasonable in the traffic circumstances, to unreasonable but somewhat likely rapid deceleration, to extremely unlikely (e.g., a sudden cut-in combined with full braking on a clear high-speed road). The analysis of the ODD and reasonably expected driving situations within the ODD should make distinctions that include an estimate of the likelihood of situations to ensure that the ADS's performance is evaluated based on response to reasonably likely occurrences involving nominal, critical and failure situations but not on the expectation that the ADS will avoid or mitigate the most extremely unlikely occurrences.[61]
2.1.3.	Object and Event Detection and Response (OEDR) Analysis: Behavioural competencies identification
	Once the objects and their reasonably expected behaviours have been identified, it is possible to map the appropriate ADS response, which can be expressed as a behavioural competency. The detailed response is derived from more general and applicable safety requirements . The acceptable ADS response will vary depending on whether the driving situation involves nominal, critical, or failure characteristics.
	The outcome of the analysis is a set of behaviour competencies that can be applied to the events characterizing the ODD. Table 2 provides a qualitative example of a matching event – response.
	The combination of objects, events, and their potential interaction, as a function of the ODD, constitute the set of potential situations pertinent to the ADS under analysis.
2.2.	Scenario Identification
	To ensure that the behavioural competencies identified in the previous paragraphs are ready to be assessed, ODD-relevant [scenarios and situations] must be identified.
	Scenario can be described at different abstraction levels (i.e. functional, abstract, logical and concrete) by focussing the scenario description on specific aspects, while leaving other details for further processing.
	Sampling techniques can be used when selecting parameters to be used in creating logical and concrete scenarios for the ADS validation for a particular ADS and its ODD to avoid the ADS being optimized for a set of known test cases.
	This approach suggests complementary methodologies to derive reasonably expectable scenarios which might occur for a given ODD:
	(a) Knowledge-based methods,
	(b) Data-based methods, and
	(c) Goal-based methods.

---

[61] *IEEE 2846 – Standard for Assumptions in Safety-Related Models for Automated Driving Systems*

A knowledge-driven scenario generation approach utilizes domain specific (or expert) knowledge to identify nominal, critical and failure events systematically and create scenarios. Examples of knowledge-driven scenarios generation approaches include:

(a) Experience acquired during ADS development,

(b) Synthetically generated scenarios from key parameter variations,

(c) Engineered scenarios based on functional safety requirements and safety of intended functionality,

(d) Composing complex scenarios from basic scenarios,

(e) Random variations of scenario parameters, both for the ADS an ORUs.

A data-driven approach utilizes the available data to identify and classify occurring scenarios. Data-driven scenarios generation approaches include:

(a) Analysing human driver behaviour, including evaluating naturalistic driving data,

(b) Collision data from accident databases, insurance records, and law enforcement authorities.

(c) Traffic patterns relevant for the ODD from real-world driving logs;

(d) Situations recorded using instrumented vehicles, the ADS vehicle's sensors, infrastructure or drones.

(e) ISMR ref

Figure 3 illustrates various data-based and knowledge-based scenario generation methods.

[While many of the knowledge based method are looking at existing data and knowledge, a different method is goal based. As the acceptance criteria are defined, they are actually setting the goals that should be demonstrated by testing and coverage, and used as evidence for for safety claims. Starting from these goals, and looking at the existing status of the evidence, gaps in testing and coverage can be identifies, and mapped back to missing scenarios that should be used for testing.]

Furthermore, existing scenarios already defined in standards, regulations or guidelines can also be utilized for the testing of ADSs. Additional scenarios include those that occur during real world trials and deployments. Such scenarios might have not been considered pre-deployment but are key learnings. At the time of publishing this text, there is significant experience gathered with existing trials and tests, and thus a significant amount of driving logs and recording can be used.

For AI centric ADS systems, training required usage of a lot of data of driving logs and recordings. The same data resources can be used to test the behavioural competencies. The challenge is to map these into the scenario categories, in order to ensure that this testing and its results are counted correctly toward the acceptance criteria evaluation.

One method to categories these logs and recordings is to match them to existing abstract scenario libraries, and classify them to nominal, critical and failure scenarios. With categorization and classification, the evaluation of this scenarios, and counting their contribution to the evidence and the success criteria, can take place.

The scenario-generation method should include adequate coverage of relevant nominal, failure, and critical [scenarios and situations] to effectively validate the ADS. "Coverage" refers to the degree to which scenarios sufficiently incorporates driving situations in order to validate the relevant requirements of this regulation. Sufficient coverage is essential to the overall effectiveness and credibility of these methodologies as a validation approach. Sufficient coverage should be with respect to the ADS feature or ODD. Coverage can be measured across different domains, and metrics can be used to determine sufficiency.

| 2.3. | Behavioural competencies and scenarios mapping |

Once relevant scenarios and behavioural competencies have been identified, it is necessary to link them. The classification in the three broad categories of driving situations an ADS might encounter such as nominal, critical and failure, serves the purpose.

| 2.3.1. | Nominal Situations Competencies |

In these situations, ADS competencies can often be derived by applying traffic laws of the country where the ADS is intended to operate, as well as by applying general safe driving principles for situations not addressed adequately by current traffic laws for human drivers. Examples of such competencies may include adherence to legal requirements to maintain a safe distance from vehicles ahead, provide pedestrians the right of way, obey traffic signs and signals, etc. Of course, some nominal competencies (e.g., safe merging, safely proceeding around road hazards) may not be explicitly articulated or mandated by traffic laws. In some instances, traffic laws may provide wide discretion for the driver to determine the safest response to a particular situation (for example, how to respond to adverse weather conditions). As such not all traffic laws are stated with sufficient specificity to provide a clear basis for defining a competency.

Therefore, an approach to codify rules of the road to provide additional specificity was developed (see Appendix 1). Additionally, application of models involving safe driving behaviour may be needed in addition to reference to codified rules of the road in developing behavioural competencies for nominal driving situations.

Table 3 provides an example of competencies and scenario mapping for nominal situations.

| 2.3.2. | Critical Situations Competencies |

The development of these competencies requires analysis of (1) what constitutes such unreasonable behaviour by ORUs and/or a sudden change of the operating conditions that are not reasonably foreseeable and (2) what constitutes an appropriate ADS response to avoid or mitigate the imminent crash. Additionally, it is also important to identify the occurrence of unplanned emergent behaviour in critical situations.

Analysis of the first type may be based on a variety of methodologies, including e.g. IEEE 2846 (which offers guidance on what behaviours by other road users are reasonably foreseeable) and other models of reasonable driving behaviour. Analysis of the second factor may be based on various models of acceptable human driving behaviour in crash imminent situations.

Hazard identification methods (e.g. STPA as mentioned in SAE J3187) which analyse the system design for functional and operational insufficiencies can help identify the occurrence of emergent behaviour which may lead to critical situations.

Development of behavioural competencies for critical driving situations faces several challenges. No general consensus exists on the appropriate models for the behaviour of ORUs or appropriate responses by the ADS to unreasonable ORU behaviours that make a crash imminent.

Table 4 provides an example of competencies and scenario mapping for critical situations.

	[Critical situation behavioural competencies should provide evidence that an ADS needs to be responsive to actions by other road users, which may make a crash unavoidable. Therefore critical scenarios should not be limited to those that are deemed preventable by the ADS. Unsafe behaviours of other road users (e.g., vehicle travelling in the wrong direction, sudden unsignalled lane changes, and exceeding the speed limit) — if reasonably foreseeable within the appropriate ODD — should be included as part of validation testing.]
2.3.3.	Failure Situations Competencies
	The ADS safety requirements include management of various failure modes. As noted above, failure situations scenarios involve those in which the ADS or another vehicle system experiences a fault or failure that compromises the ADS's ability to perform the DDT, such as sensor or computer failure or a failed propulsion system.
	In developing the behavioural competencies appropriate for failure situations, the objective is to describe the ability of the ADS to detect and respond safely to specific types of faults and failures. Depending upon the nature and extent of the fault or failure, the responses can include identifying a minor fault for immediate repair after trip completion, responding to a significant fault with restrictions (such as limp-home mode) for the remainder of the trip, or responding to major failures by achieving a [mitigated] risk condition. Communication of the fault or failure condition to vehicle users may also be a desirable ADS behavioural competency.
Table 5 provides an example of competencies and scenario mapping for failure situations.	
2.4.	Assumptions
	Concrete performance requirements depend on the specific situations the ADS encounters, on a reference behaviour that is deemed appropriate for a human driver or a technical system, and on assumptions (e.g. cut-in speed values, reaction times, …) about the behaviour of the vehicle and other road users. Assumptions concerning the actions of other road users may need to account for cultural differences in driving styles in different geolocations, making it impracticable to harmonise these assumptions across different domains. Therefore, evidence should be provided to support the assumptions made. Existing standards e.g. IEEE 2846-2022 provide a set of assumptions to be considered by ADS safety-related models for an initial set of driving situations. Additionally, several other tools including data collection campaigns performed during the development phase, real-world accident analysis and realistic driving behaviour evaluations, constraint randomisation, Bayesian optimisation besides others can be used to inform values for such assumptions.
2.5.	Performance Evaluation
	As previously highlighted, nominal situations are considered reasonably foreseeable for a given ODD and therefore it is expected that the ADS would be capable of handling them without any resulting collision.
	On the other hand, failure situations are performed to assess the ADS ability to recognise faults/failures in the system and safely react to such cases.
	For the purpose of defining performance criteria in critical situations, those where others are at fault, behaving unforeseeably, and the collision might potentially not be prevented have to be analysed further. In these situations, different considerations can be made.
2.5.1.	Evaluation of target evidence and residual risk

	As testing by the manufacturer is an ongoing process, the outcome of the testing is constantly evaluated. The goal of the evaluation is to assess if sufficient evidence to support the claims of the safety case is achieved, and if an assessment of an acceptable residual risk can be developed. This evaluation is major input to the decision of acceptance criteria are met, or if more scenarios and tests are required. If more are required, then additional effort is invested (by using all method shown above) in increasing the ODD and scenario coverage, until the goals of the acceptance criteria is met.
2.5.2.	Application of Rules of Road
	An approach to define an acceptance criterion related to nominal driving situations is to evaluate the ADS performance against the rules of the road. Furthermore, ADS safety requirements state that, "The ADS shall comply with traffic rules in accordance with application of relevant law within the area of operation."
	It is challenging to test against this requirement in the absence of codified rules of the road.
	One possible approach is the codification of Rules of the Road; Figure 3 illustrates the using of Rules of the Road as pass-criteria for individual scenarios. The following approach for codification of Rules of the Road can be used to link individual rules with corresponding scenarios using ODD and behaviour labels.
	Current rules of the road (for human drivers) have three components:
	Operating conditions include both ODD aspects and vehicle states (e.g., system failures, hardware failures etc.). Every set of traffic laws or behaviour rules (for human drivers) defined in any country are based on an understanding of the expected behaviours of human drivers. As a result, they do not explicitly define all aspects of the expected driving behaviour but can be argued to include "implicit assumptions" based on this understanding.
	Following the process (illustrated in section 8.1), a "codified" rule of the road for an automated driving system, will also have three components:
	Codified Rule of road = Operating condition + Behaviour competency + Driving decisions
	The process of codification helps identify where "implicit assumptions" about driving behaviour are present in the rules for human drivers. The codified rules of the road help to turn "undefined" attributes in the rules of the road (for human drivers) to "defined" attributes in the codified "rules of the road".

Annex 6.	Data Storage Systems for Automated Driving	Annex 8.	Data Storage Systems for Automated Driving
1.	This annex defines Data Storage System for Automated Driving (DSSAD) as the data storage capability of a vehicle to monitor the safety performance of ADS, and establishes requirements to enable the evaluation of ADS safety performance.		
2.	Data Storage and Security		
2.1	The DSSAD shall be capable of recording and storing time-stamped and time-series data elements as defined in Paragraph 5 of this Annex.		
2.2	The DSSAD shall be protected against both unauthorized access and manipulation.		
2.3	In the case of the data intended to be stored off-board the vehicle cannot be transmitted, it shall remain stored on the vehicle.		
3.	Data Format		
3.1	Each data element listed in Paragraph 5 of this Annex shall be available in a standardized and readable format.		
3.2	Time stamp data format		
3.2.1.	Time stamp data shall be recorded in a clearly identifiable way with following data:		
	(a) The time stamped data element, as listed in paragraph 5.2.1.		
	(b) The additional information noted in 5.2 for each time stamped data element as appropriate.		
	(c) Date (Resolution: yyyy/mm/dd);		
	(d) Timestamp		
	(i) Resolution: hh/mm/ss timezone e.g. 12:59:59 UTC;		
	(ii) Accuracy: +/- 1.0 s.		
3.2.2.	A single timestamp may be allowed for multiple elements recorded simultaneously within the time resolution of the specific data elements. If more than one element is recorded with the same timestamp, the information from the individual elements shall indicate the chronological order.		
4.	Data Accessibility		
4.1 All of the stored data defined in Paragraph 5 of this Annex shall be readily accessible to authorized entities as defined under national law.			
[4.2 The manufacturer shall ensure the data is promptly available in a format that is standardized and readable as outlined in Paragraph 3.1. Information on interpretation of the outputted data must be documented by the manufacturer and provided upon the request of an authorized entity and interpretation shall not require any proprietary tools or systems.]			
4.3 The DSSAD data (whether stored on or off-board the vehicle) shall be available and retrievable through an electronic communication interface that complies with a publicly available interface standard. It is recommended to use an internationally recognized standard.			

[4.4 The manufacturer shall ensure there is a method to access the data via the electronic communication interface and provide an information package about its usage to the relevant authority. The method of accessing data via this interface shall be documented by the manufacturer and provided upon the request of an authorized entity. If the data is [intended to be] stored onboard the vehicle then the manufacturer shall provide an authorized entity, free of charge, any tools or software which are required for access. If the data is [intended to be] stored offboard the vehicle then an authorized entity shall not [have to install any systems or require any proprietary tools or systems to access the data.]]

4.5 The stored data shall be retrievable even when the main onboard vehicle power supply is not available

5. Data Elements:

5.1 The DSSAD shall record and store the data elements listed below.

5.2 Data elements of time-stamp data

5.2.1. The following table details the data elements of time-stamp data to be recorded, along with any additional information and recording condition.

Event	Additional Information	Recording condition
Activation of the feature	ADS feature is activated by the: (i) system, or (ii) user	
Deactivation of the feature	ADS feature is deactivated by the (i) system, or (ii) user	Whilst the feature is active
Start of ADS fallback to user, if applicable	System-initiated deactivation of the ADS initiated due to: (i) Planned event, (ii) Unplanned event, (iii) [Detection that fallback user is not available,] (iv) System failure, (v) Input to the driving controls, or (vi) Exit of ODD.	Whilst the feature is active
Start of ADS fallback to an MRC	MRC resulting from: (i) exit of ODD, (ii) ADS failure, (iii) collision detected, (iv) [Absence of a **Detection that** fallback user **is not available**, if applicable, or] (v) failure of the fallback user to take control following a system-initiated deactivation of the ADS.	Whilst the feature is active
User input to the driving controls, if applicable	Application of: (i) brake control, (ii) acceleration control, (iii) steering control, or (iv) direction indicator.	Whilst the feature is active
Prevention of user takeover, if applicable	Prevention of user takeover (if applicable) due to: (i) Unintentional user input, (ii) The current situation being unsuitable, (iii) The current situation being unsafe, or (iv) The user not being suitably engaged.	Whilst the feature is active

[Detection that fallback user is not available, if applicable]		Whilst the feature is active
Start of Emergency Manoeuvre		Whilst the feature is active
End of Emergency Manoeuvre		Whilst the feature is active
Event Data Recorder (EDR) trigger input[62]		Whilst the feature is active
Detected collision		Whilst the feature is active
Detected severe failure[63]	The failure could include the following: (i) ADS (ii) Sensor (iii) Other vehicle systems (mechanical, electrical, etc.)	Whilst the feature is active

5.3 Time series data elements

5.3.1. The data elements shall be recorded in compliance with paragraph 5.3.X if the following thresholds are reached or conditions occur: a) Detected collision b) EDR trigger input (excluding last stop trigger)

---

[62] Excluding any last stop trigger
[63] A failure would be severe if it is one that prevents the ADS from performing the DDT in accordance with the Paragraph of 4.2 this regulation.

Data element	Condition for requirement	Recording interval/time (relative to time stamp)
Detected object distance, longitudinal	Mandatory if available	
Detected object distance, lateral	Mandatory if available	
Detected object relative velocity, longitudinal	Mandatory if available	
Detected object relative velocity, lateral	Mandatory if available	
Detected object classification	Mandatory if available	
Sensor data[64]	Mandatory if 'Detected object elements' are not available	
ADS-requested accel demand	Mandatory	
ADS-requested service braking demand	Mandatory	
ADS-requested parking brake demand	Mandatory	

ADS-requested steering demand	Mandatory	
Vehicle acceleration, longitudinal	Mandatory	
Vehicle acceleration, lateral	Mandatory	
ADS-determined vehicle speed	Mandatory	

---

[64] e.g. camera, radar, LiDAR, used by the ADS for decision making. This shall be documented in the information package provided to the Authorised Entity. This shall include a "Visual Representation" submitted to the Authorised Entity at the time of providing the DSSAD Data, and shall comply with the requirements of 3.1 and 4.4 of this Annex.

Figure 1. Relationships across safety requirements, ODD analysis and scenario generation, and validation pillars
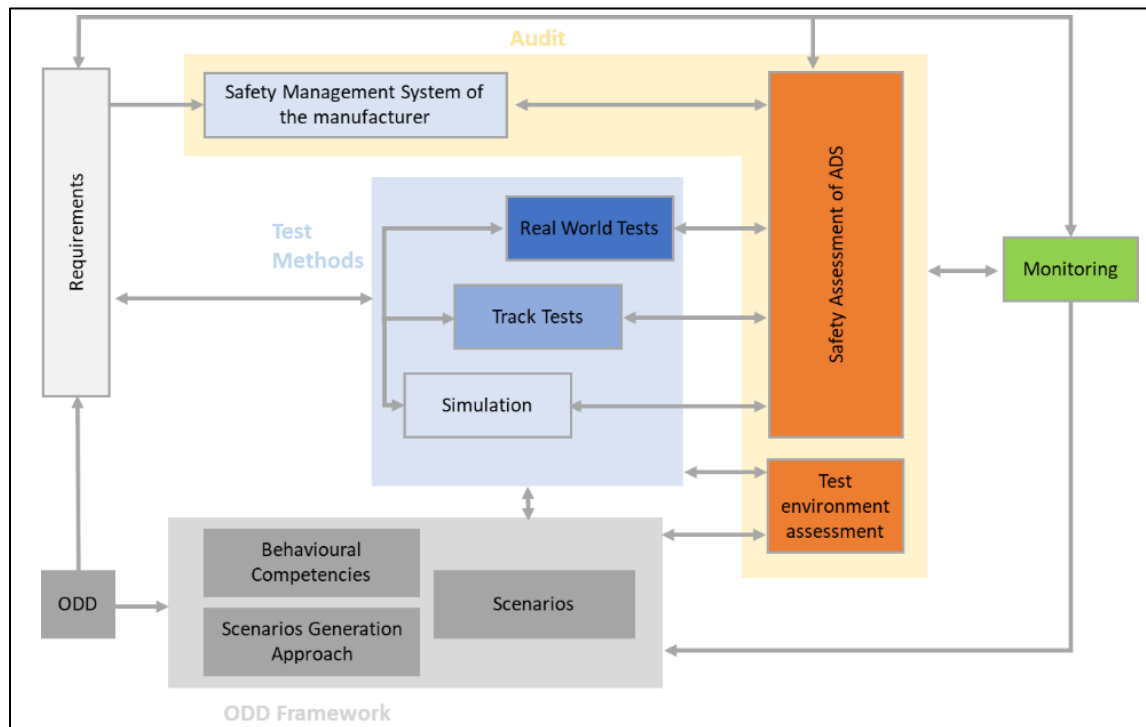
Figure 2. Example of a possible approach to identify behavioural competencies and scenarios
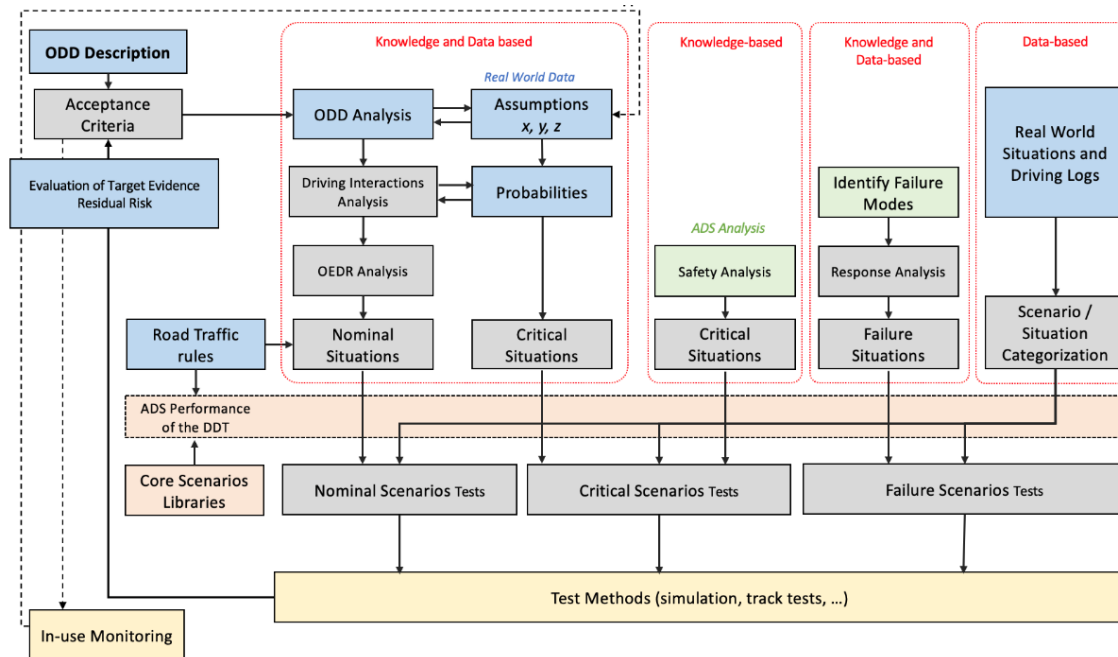
Figure 3. Examples of Data and Knowledge-based generation methods

Accident databases	Real world data Telematics Insurance claims	Analytical Hazard Based Approach (STPA)	Formal Verification (Highway Code)	Operational Design Domain (ODD)	Ontology	Standards regulations guidelines	Real-world deployment and trials
What are the causes of known accidents?	*What are the near-miss events?*	*What are the potential causes of failures?*	*What are the known unsafe situations by regulations?*	*What are the known safe boundaries for the ADSs?*	*What are the scenarios within a set of constraints?*	*What are the existing scenarios set out?*	*What unsafe situations do we know during trials?*

Scenario library: Scenario Database

Scenario description language

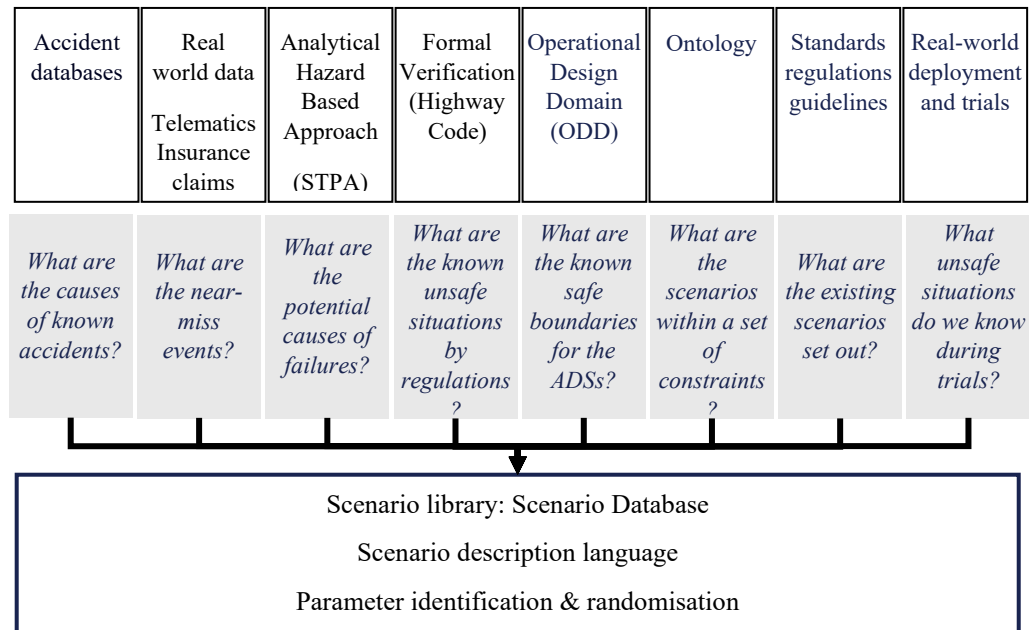Parameter identification & randomisation

Table 1. Examples of Static / Dynamic elements and their properties

Objects	Events/Interactions
Vehicles (e.g. cars, light trucks, heavy trucks, buses, motorcycles)	Lead vehicle decelerating, Lead vehicle stopped, Lead vehicle accelerating, Changing lanes, Cutting in, Turning, Encroaching opposite vehicle, Encroaching adjacent vehicle, Entering roadway, Cutting out, …
Pedestrians	Crossing road -inside crosswalk, Crossing Road – outside crosswalk, Walking on sidewalk / shoulder
Cyclists	Riding in lane, Riding in adjacent lane, Riding in dedicated lane, Riding on sidewalk/shoulder, Crossing road – inside/outside crosswalk, …
Animals	Static in lane, Moving into/out of lane, Static/Moving in adjacent lane, Static/Moving on shoulder, …
Debris	Static in lane
Other dynamic objects (e.g. shopping carts)	Static in lane, Moving into/out of lane, …
Traffic signs	Stop,

	Yield, Speed limit, Crosswalk, Railroad crossing School zone, …
Vehicle signals	Turn signals

Table 2. Example of elementary behavioural competencies for given events.

Event	Response
Lead vehicle decelerating	Follow vehicle, decelerate, stop
Lead vehicle stopped	Decelerate, stop
Lead vehicle accelerating	Accelerate, follow vehicle
Lead vehicle turning	Decelerate, stop
Vehicle changing lanes	Yield, decelerate, follow vehicle
Vehicle cutting in	Yield, decelerate, stop, follow vehicle
Opposite vehicle encroaching	Decelerate, stop, shift within lane, shift outside lane
Adjacent vehicle encroaching	Yield, decelerate, stop
Lead vehicle cutting out	Accelerate, decelerate, stop
Pedestrian crossing road	Yield, decelerate, stop
Cyclist riding in lane	Yield, follow
Cyclist crossing road	Yield, decelerate, stop

Table 3. Example of competencies and scenario mapping in nominal situations

ODD Element	Driving Behaviour	Traffic Rule	ADS Requirements	Behavioural Competency	Test Scenario
Bicycle	Riding in lane		5.1.2.5. The ADS shall adapt its driving behaviour in line with safety risks	The ADS ensures relative velocity during passing manoeuvre does not exceed [30] km/h	The ADS travels between [30–50]km/h on the centre line of its lane
		Drivers will need to use a minimum passing distance for bicycles of 1.5m in urban areas, and 2m out of town	5.1.2.9. The ADS shall comply with traffic rules in accordance with application of relevant law within the area of operation.	The ADS shifts in lane to pass by cyclist with 1.5.m lateral distance	A cyclist travels in the same direction as the ADS between [10–20] km/h, [0.2–1] m away from the lane edge
			5.1.2.4. The ADS shall avoid unreasonable disruption to the flow of traffic in line with safety risks.	The ADS crosses the centre lane marking to ensure the safe passing distance is not violated	
			5.1.2.10. The ADS shall interact safely with other road users	The ADS activates the turn signal if the centre lane marking is crossed	

Table 4. Example of competencies and scenario mapping in critical situations

Losses	Hazards	Unsafe Control Action	Loss scenario	Causal factors	Behavioural Competency	Test Scenario
Collision with object outside the vehicle	ADS does not maintain a safe distance from the lead motor vehicle	Braking demand is not provided	Object in vehicle trajectory is not detected	Undetected/misclassified object; Obscured object; Incorrect sensor fusion result	The ADS is following behind a lead vehicle, with the headway set by the ADS.	Lead vehicle decelerated to turn [right/left] or travel straight on a [mini /large] roundabout
			Object is not considered to be in the vehicle trajectory	Localisation issues leading to incorrect positioning of ego vehicle or object	The lead vehicle decelerates at the max assumed rate depending on the weather conditions	Lead vehicle decelerated whilst shifting lane to avoid a [static object/other road user]

Table 5. Example of competencies and scenario mapping in failure situation

Failure Type	Failure Mode	Potential Cause	Behaviour Competency	ADS Requirements	Test Scenario	Pass / Fail Criteria
Perception	Fail to identify ODD boundary	Failure to detect ODD attribute e.g. heavy rain/fog	Safely stop in lane of travel	5.1.5.1. The ADS shall recognise the conditions and boundaries of the ODD of its feature(s)	The ADS operates beyond the predicted ODD	The ADS detects the ODD conditions are not met and issues a minimal risk manoeuvre
				5.1.4.3. In response to a fault, the ADS shall either execute a fallback response and prohibit activation of the impacted feature(s) if the fault prevents the ADS from performing the DDT in accordance with the requirements		The minimum risk manoeuvre should not cause the vehicle to decelerate greater than [4]m/s2

				of 5.1., or adapt its performance of the DDT in accordance with the severity of the fault provided the resulting performance complies with the requirements of section 5.1		