This document provides Integration Group recommendations for terms and definitions for the joint submission based on the proposals in the respective FRAV and VMAD documents.

The following colour coding provides transparency over changes. These proposals have been accepted by the Integration Group for recommendation to FRAV and VMAD with two terms highlighted in orange where the Integration Group requests additional guidance from VMAD.

Text in green signifies no change from the FRAV/VMAD documents.
Text in yellow signifies reconciliation between FRAV and VMAD documents.
Text in light blue signifies minor editorial change for clarity and/or consistency across definitions.
Text in purple signifies significant editorial change that should be reviewed to ensure consistency with original intents.
Text in orange signals an open issue.

Proposals recommended by the Integration Group		Based on	
		FRAV	VMAD
3.1.	*"Abstraction"* means a process of selecting relevant aspects of a source or referent system to be represented in a model or simulation.		*"Abstraction"* is the process of selecting the essential aspects of a source system or referent system to be represented in a model or simulation, while ignoring those aspects not relevant. Any modelling abstraction carries with it the assumption that it should not significantly affect the intended uses of the simulation tool.
3.2.	*"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.[1]	*"Automated Driving System (ADS)"* means the hardware and software that are collectively capable of performing the entire DDT on a sustained basis regardless of	*"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.

[1] 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.

		whether it is limited to a specific operational design domain (ODD).	
3.3.	*"ADS feature"* means an ADS functionality designed specifically for use within an Operational Design Domain (ODD).	*"(ADS) feature"* means an application of ADS hardware and software designed specifically for use within an ODD.	*"ADS feature"* means an application of an ADS designed specifically for use within an Operation Design Domain (ODD).
3.4.	*"(ADS) function"* means an ADS hardware and software capability designed to perform a specific portion of the DDT.	*"(ADS) function"* means an ADS hardware and software capability designed to perform a specific portion of the DDT.	*"ADS function"* means an application of ADS hardware and software designed to perform a specific portion of the DDT.
3.5.	*"ADS vehicle"* means a vehicle equipped with an ADS.	*"ADS vehicle"* means a vehicle equipped with an ADS.	
3.6.	*"Behavioural competency"* means an expected and verifiable capability of an ADS feature to operate a vehicle within the ODD of the feature.	*"Behavioural competency"* means an expected and verifiable capability of an ADS feature to operate a vehicle within the ODD of the feature.	
3.7.	*"Closed-loop testing*" means testing in an environment in which actions of the ADS hardware, software, or other element(s) in the loop influence the actions of other objects in the simulation.[2]		*"Closed Loop Testing*" means a virtual environment that does take the actions of the element-in-the loop into account. Simulated objects respond to the actions of the system (e.g. system interacting with a traffic model).
3.8.	*"Open-loop testing*" means testing in an environment in which the actions of the ADS hardware, software, or other element(s) in the loop do not affect the actions of other objects in the simulation.[3]		*"Open Loop Testing*" means a virtual environment that does not take the actions of the element-in-the loop into account (e.g. system interacting with a recorded traffic situation).
Open Issue: Should this definition be retained? Complex tools like ADS and fully virtual environments for testing ADS are unlikely to ever be 100% deterministic. The term is only used once in the text in reference to the use of stochastic models and seems			*"Deterministic*" is a term describing a system whose time evolution can be predicted exactly and a given set of input stimuli will always produce the same output.

[2] For example, evaluating ADS interactions with other objects that respond to the actions of the ADS within a traffic model.
[3] For example, evaluating ADS interaction with a recorded traffic situation.

paired with “probabilistic” which is not used in the text. If retained, it would be preferable to use the “*term* means” format and to clarify the meaning of “system”.		
Open Issue: Should this term be retained even though it is not used in the VMAD text? If retained, it would be preferable to use the “*term* means” format. To what specifically is the term “probabilistic” applied?		*“Probabilistic*” is a term pertaining to non-deterministic events, the outcomes of which are described by a measure of likelihood.
3.9. *“Stochastic*” means a process involving or containing a random variable or variables pertaining to chance or probability.		*“Stochastic*” means a process involving or containing a random variable or variables. Pertaining to chance or probability.
3.10. *“Driver”* means a human user who performs in real time part or all of the DDT and/or DDT fallback for a particular vehicle.	*“Driver”* means a human being who performs in real time part or all of the DDT.	
3.11. *“Dynamic Driving Task (DDT)”* means the real-time operational and tactical functions required to operate the vehicle in on-road traffic.	*“Dynamic Driving Task (DDT)”* means the real-time operational and tactical functions required to operate the vehicle in on-road traffic.	*“Dynamic driving task (DDT)”* means all of the real-time operational and tactical ADS functions required to operate the ADS-equipped vehicle in on-road traffic.
3.11.1. The DDT is always performed in its entirety by the ADS in operation (“the entire DDT” as stated in the definition of an “Automated Driving System” under para. 3.2.) which means the whole of the tactical and operational functions necessary to operate the vehicle. These functions can be grouped into three interdependent categories: sensing and perception, planning and decision, and control.		
3.11.1.1. Sensing and perception include: • Monitoring the driving environment via object and event detection, recognition, and classification. • Perceiving other vehicles and road users, the roadway and its fixtures, objects in the		

vehicle's driving environment and relevant environmental conditions. • Sensing the ODD boundaries, if any, of the ADS feature. • Positional awareness.		
3.11.1.2. Planning and decision include: • Predicting actions of other road users. • Response preparation. • Manoeuvre planning.		
3.11.1.3. Control includes: • Object and event response execution. • Lateral vehicle motion control. • Longitudinal vehicle motion control. • Enhancing conspicuity via lighting and signalling.		
3.11.1.4. The DDT excludes strategic functions.		
3.11.2. *"Strategic function"* means a capability to issue commands, instructions, or guidance for execution by an ADS.[4]	*"Strategic function"* means a capability to issue commands, instructions, or guidance for execution by an ADS.	
3.11.3. *"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.[5]	*"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.	
3.11.4. *"Operational function"* means a capability to control the real-time motion of the vehicle.[6]	*"Operational function"* means a capability to control the real-time motion of the vehicle.	

[4] Examples include setting the starting point, destination, route, and way points to be used by an ADS during a trip.
[5] 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.
[6] 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.

3.12.	*"Edge Case*" means a low-frequency occurrence that might arise within the ODD of an ADS and warrants specific design attention due to the potential severity of outcomes that might result from encountering such a situation or condition across a full-scale deployed fleet of such ADS vehicles.[7]		*"Edge Case*" is a rare situation that may require specific design attention for it to be dealt with by the ADS in a reasonable and safe way if warranted by the possible severity and likely frequency within the ODD of the ADS. The quantification of "rare" is relative, and generally refers to situations or conditions that will occur often enough in a full-scale deployed fleet to be a problem but may have not been captured in the design process. Edge cases can be individual unexpected events, such as the appearance of a unique road sign or an unexpected animal type on a highway.
3.13.	*"ADS fallback response"* means an ADS-initiated transition of control or an ADS-controlled procedure to place the vehicle in a minimal risk condition.	*"(ADS) fallback response"* means an ADS-initiated transition of control or an ADS-controlled procedure to place the vehicle in a minimal risk condition.	
3.14.	*"DDT fallback"* means a response by the user to either perform the DDT or to achieve a minimal risk condition or a response by an ADS to achieve a minimal risk condition: (1) after the occurrence of one or more DDT performance-relevant system failures, or (2) upon an ODD exit.	Propose to add term used in the text.	
3.15.	*"Fallback user"* means a user expected to perform the DDT pursuant to a transition of control.	[*"Fallback user"* means a user designated to perform the DDT pursuant to an ADS fallback response.]	
3.16.	*"Minimal Risk Condition (MRC)"* means a stable and stopped state of the vehicle that reduces the risk of a crash.	*"Minimal Risk Condition (MRC)"* means a stable and stopped state of the vehicle that reduces the risk of a crash.	

[7] Examples include a unique road sign or an unusual animal type in the roadway.

3.17.	*"Model"* means a description or representation of a system, entity, phenomenon, or process.		*"Model"* is a description or representation of a system, entity, phenomenon, or process.
3.18.	*"Model calibration"* means a process of adjusting numerical or modelling parameters in a model to improve agreement with a referent.		*"Model calibration"* is the process of adjusting numerical or modelling parameters in the model to improve agreement with a referent.
3.19.	*"Model parameter"* means a numerical value inferred from real-world data and used to characterise a system functionality.		*"Model Parameter"* are numerical values used to support characterizing a system functionality. A model parameter has a value that cannot be observed directly in the real world but that must be inferred from data collected in the real world (in the model calibration phase).
3.20.	"*Occurrence*" means a safety-relevant event involving an ADS vehicle.		"*Occurrence*" refers to any safety-related event involving a vehicle equipped with an ADS. For reporting, two different categories of occurrences are defined.
3.21.	"*Non-critical Occurrence*" means an operational interruption, defect, fault, or other circumstance that influenced or may have influenced ADS safety but did not result in a collision or serious incident.[8]		"*Non-critical Occurrence*" means an operational interruption, defect, fault or other circumstance that has or may have influenced ADS safety but has not resulted in an accident or serious incident. This category includes for example minor incidents, safety degradation not preventing normal operation, emergency/complex manoeuvres to prevent a collision, and more generally all occurrences relevant to the safety performance of the in-service ADS (like transfer of control, interaction with remote operator, etc.).

[8] Examples include minor incidents, safety degradation not preventing normal operation, emergency/complex manoeuvres to prevent a collision, and more generally all occurrences relevant to the safety performance of the in-service ADS (like transfer of control, interaction with remote operator, etc.).

3.22.	*"Critical Occurrence"* means an occurrence during which the ADS is performing the DDT and: (a) at least one person suffers an injury that requires medical attention 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 an airbag deployment.		*"Critical Occurrence"* means an occurrence in which the ADS is engaged at the time of the event and: (a) at least one person suffers an injury that requires medical attention 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 an airbag deployment.
3.23.	*"Operational Design Domain (ODD)"* means the operating conditions under which an ADS feature is specifically designed to function.[9]	*"Operational Design Domain (ODD)"* means the operating conditions under which an ADS feature is specifically designed to function.	"*Operational Design Domain (ODD)*" means the operating conditions under which an ADS feature is specifically designed to function.
3.24.	"*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.[10]		"*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.
3.25.	*"Other road user (ORU)"* means an entity in the ADS vehicle environment capable of motion and coordinated interaction with the ADS vehicle.	[*"Other road user (ORU)"* means an entity in the ADS vehicle environment capable of motion and coordinated interaction with the ADS vehicle.]	

[9] Examples include but are not limited to environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.

[10] ODD conditions are distinct from ADS capabilities. An ADS may be designed to manage transient changes in the operating environment where such transient changes do not represent an ODD exit.

3.26.	*"Priority vehicle"* means a vehicle subject to exemptions, authorizations, and/or right-of-way under traffic laws while performing a specified function.	*"Priority vehicle"* means a vehicle subject to exemptions, authorizations, and/or right-of-way under traffic laws while performing a specified function.	
3.27.	*"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, including via sensor stimulation and/or the use of dummy devices.		*"Proving Ground or test-track*" is a physical testing facility closed to the traffic where the performance of an ADS can be investigated on the real vehicle. Traffic agents can be introduced via sensor stimulation or via dummy devices positioned on the track.
3.28.	*"Real time"* means the actual time during which a process or event occurs.	*"Real time"* means the actual time during which a process or event occurs.	
3.29.	*"Road-safety agent"* means a human being engaged in directing traffic, enforcing traffic laws, maintaining/constructing roadways, and/or responding to traffic incidents.	*"Road-safety agent"* means a human being engaged in directing traffic, enforcing traffic laws, maintaining/constructing roadways, and/or responding to traffic incidents.	
3.30.	*"Safety case"* means a compelling, comprehensible, and valid argument, supported by a body of evidence, documenting that a system is, or will be, adequately safe for a given application in a given environment.	Based on existing standards while remaining consistent with original definition.	*"Safety Case"* is the documented argument and supporting evidence that safety is achieved and maintained in the organization.
3.31.	*"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.		*"Sensor Stimulation*" is a technique whereby artificially generated signals are provided to the element under testing in order to trigger it to produce the result required for verification of the real world, training, maintenance, or for research and development
3.32.	*"Simulation"* means the imitation of the operation of a real-world process or system over time.		*"Simulation"* is the imitation of the operation of a real-world process or system over time.

3.33.	*"Simulation toolchain*" means a combination of simulation tools that are used to support the validation of an ADS.		*"Simulation toolchain*" is a combination of simulation tools that are used to support the validation of an ADS.
3.34.	*"Test case specification*" means the detailed specifications of what must be done by the tester to prepare for the test.		*"Test case specification*" are the detailed specifications of what must be done by the tester to prepare for the test.
3.35.	*"Test methods*" means a structured approach to consistently derive knowledge about the ADS by means of executing tests.[11]		*"Test methods*" is a structured approach to consistently derive knowledge about the ADS by means for executing tests, e.g., virtual testing in simulated environments, physical, structured testing in controlled test facility environments, and real world on-road conditions.

[11] For example, virtual testing in simulated environments, physical, structured testing in controlled test-facility environments, and real-world on-road conditions.

3.36.	*"Traffic scenario"* means a description of one or more real-world driving situations that may occur during a given trip.[12]	*"Traffic scenario"* means a description of one or more real-world driving situations that may occur during a given trip.	*"Traffic scenario*" (or scenario for short) is a sequence or combination of situations used to assess the safety requirements for an ADS. Scenarios include a driving manoeuvre or sequence of driving manoeuvres. Scenarios can also involve a wide range of elements, such as some or all portions of the DDT; different roadway layouts; different types of road users and objects exhibiting static or diverse dynamic behaviours; and, diverse environmental conditions (among many other factors).
3.36.1.	*"Nominal scenario"* means a traffic scenario representing usual and/or expected objects, object behaviours and/or road conditions.	[*"Nominal scenario"* means a traffic scenario representing usual and/or expected objects, object behaviours and/or road conditions.]	*"Nominal Scenarios*" means a traffic scenario containing situations that reflect regular and non-critical driving manoeuvres.
3.36.2.	*"Critical scenario"* means a traffic scenario representing unusual and/or unexpected objects, object behaviours, and/or road conditions.	[*"Critical scenario"* means a traffic scenario representing unusual and/or unexpected objects, object behaviours, and/or road conditions.]	*"Critical Scenarios*" means a traffic scenario containing a situation in which the ADS needs to perform an emergency maneuver in order to avoid/mitigate a potential collision, or react to a system failure.
3.36.3.	*"Failure scenario"* means a traffic scenario representing a system failure that compromises the capability of the ADS to perform the entire DDT.	*"Failure scenario"* means a traffic scenario representing a system failure that compromises the capability of the ADS to perform the entire DDT.	
3.36.4.	*"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.[13]		*"Functional Scenario*": Scenarios with the highest level of abstraction, outlining the core concept of the scenario, such as a basic description of the ego vehicle's actions; the interactions of the ego vehicle with other

[12] Scenarios include a driving manoeuvre or sequence of driving manoeuvres. Scenarios can also involve a wide range of elements, such as some or all portions of the DDT, different roadway layouts, different types of road users and objects exhibiting static or diverse dynamic behaviours, and diverse environmental conditions (among many other factors).

[13] 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.

		road users and objects; and other elements that compose the scenario (e.g. environmental conditions etc.). This approach uses accessible language to describe the situation and its corresponding elements. For the scenario catalogue, such an accessible (i.e., natural and non-technical) language needs to be standardised to ensure common understanding between different ADS stakeholders about the scenarios.
3.36.5. *"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.[14]		*"Logical Scenario":* Building off the elements identified within the functional scenario, developers generate a logical scenario by selecting value ranges or probability distributions for each element within a scenario (e.g., the possible width of a lane in meters).
3.36.6. *"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.		*"Concrete Scenarios*": Concrete scenarios are established by selecting specific values for each element. This step ensures that a specific test scenario is reproducible. In addition, for each logical scenario with continuous ranges, any number of concrete scenarios can be developed, helping to ensure a vehicle is exposed to a wide variety of situations.
3.36.7. *"Complex Scenario*" means a traffic scenario containing one or more situations that involve a large number of other road users, unlikely road infrastructure, or abnormal geographic/environmental conditions.		*"Complex Scenarios*" means a traffic scenario containing one or more situations that involve a large number of other road users, unlikely road infrastructure, or abnormal geographic/environmental conditions.

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

3.37.	*"Transition of control (TOC)"* means a procedure by which the ADS transfers performance of the DDT to an ADS vehicle user.	[*"Transition of control (TOC)"* means a procedure by which the ADS involves the user in performance of the DDT.]	"*Transfer of Control (TOC)"* means a transfer of dynamic control of the vehicle from the ADS to the ADS vehicle user.
3.38.	*"TOC request"* means an alert issued by an ADS to an ADS vehicle user prompting the user to intervene in performance of the DDT.[15]	Reconsider. Presently not used in the FRAV and VMAD texts as submitted to WP.29 in June.	"*TOC request*" means a warning issued by the ADS to the fallback user that the latter is needed to engage in dynamic control of the vehicle.
3.39.	"*TOC response*" means an ADS vehicle user intervention in performance of the DDT pursuant to a TOC request.	Reconsider. Presently not used in the FRAV and VMAD texts as submitted to WP.29 in June.	"*TOC response*" means the fallback user engagement in the dynamic control of the vehicle pursuant to a TOC request.
3.40.	*"(ADS) User"* means a human user of an ADS vehicle.	*"(ADS) User"* means a human being using an ADS where dynamic control of the vehicle is entirely maintained on a sustained basis by the ADS performance of the DDT.	
3.41.	*"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.	*"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.	
3.42.	*"Validation of the 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 the intended uses of the tool.		*"Validation of the simulation model*" is the process of determining the degree to which a simulation model is an accurate representation of the real world from the perspective of the intended uses of the tool.
3.43.	*"Verification of the 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		*"Verification of the simulation model*" is 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

[15] The TOC request, depending on the ADS design and reason for initiation of the transition of control, may aim to engage the user in performing the DDT (i.e., to the role of driver manually operating the vehicle) or to achieve an MRC.

	models, mathematical models, or other constructs.		models, mathematical models, or other constructs.
3.44.	*"Virtual testing*" means the process of testing a system using one or more simulation models.		*"Virtual testing*" is the process of testing a system using one or more simulation models.
3.45.	*"Driver-In-the-Loop*" *(DIL*) means a driving simulator with components to enable the driver to operate in and communicate with the virtual environment and used to assess the human-automation interaction design.		*"Driver-In-the-Loop*" *(DIL*) is typically conducted in a driving simulator used for testing the human–automation interaction design. DIL has components for the driver to operate and communicate with the virtual environment.
3.46.	"*Hardware-In-the-Loop*" (HIL) means the hardware of a specific vehicle subsystem running the software with input and output connected to a simulation environment to replicate sensors, actuators, and mechanical components in a way that connects all the I/O of the Electronic Control Units (ECU) before the final system is integrated.		"*Hardware-In-the-Loop*" (HIL) involves the final hardware of a specific vehicle sub-system running the final software with input and output connected to a simulation environment to perform virtual testing. HIL testing provides a way of replicating sensors, actuators and mechanical components in a way that connects all the I/O of the Electronic Control Units (ECU) being tested, long before the final system is integrated.
3.47.	*"Model-In-the-Loop*" (MIL) means high-level-of-abstraction software frameworks running on general-purpose computing systems to enable quick algorithmic development without involving dedicated hardware.		*"Model-In-the-Loop*" (MIL) is an approach which allows quick algorithmic development without involving dedicated hardware. Usually, this level of development involves high-level abstraction software frameworks running on general-purpose computing systems.
3.48.	*"Software-In-the-Loop*" (SIL) means a methodology where executable code such as algorithms, an entire controller strategy, or a complete software implementation is assessed within a modelling environment on general-purpose computing systems.		*"Software-In-the-Loop*" (SIL) is where the implementation of the developed model will be evaluated on general-purpose computing systems. This step can use a complete software implementation very close to the final one. SIL testing is used to describe a test

		methodology, where executable code such as algorithms (or even an entire controller strategy), is tested within a modelling environment that can help prove or test the software.
3.49. *"Vehicle -In-the-Loop"* (VIL) means a fusion of real-world and virtual environments to assess the dynamics of a physical ADS vehicle on a vehicle test bed or a test track at the same level as real-world testing.		*"Vehicle -In-the-Loop"* (VIL) is a fusion environment of a real testing vehicle in the real-world and a virtual environment. It can reflect vehicle dynamics at the same level as the real-world and it can be operated on a vehicle test bed or on a test track.