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LIVRABLE L2.2 -2

ODD : Définition & Canevas de description

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Acronymes

STRA	Systèmes de Transport Routiers Automatisés
ODD	Domaine de Conception Fonctionnelle (de l'anglais Operational Design Domain)
PFA	Plateforme de la Filière Automobile
SAM	Sécurité et Acceptibilité de la Mobilité autonome
ADS	Automated Driving System
ALKS	Automated Lane Keeping System

Introduction

Dans le cadre de la tâche 2.2 « déclinaison des objectifs de sécurité sur une architecture fonctionnelle générique », il a été décidé par les partenaires de décrire et de définir de manière commune et harmonisée les conditions d'emploi en sécurité d'un système automatisé, un élément important des dossiers de sécurité règlementaires. L'acronyme ODD, de l'anglais, **O**perational **D**esign **D**omain, est communément utilisé. Suivant le périmètre technique du système considéré, au sens du Décret n° 2021-873 du 29 juin 2021, les conditions d'emploi en sécurité ont, en français, des appellations spécifiques :

Périmètre technique	**Conditions d'emploi en sécurité =**
SCA : Système de Conduite Automatisé	Domaine de conception fonctionnelle du SCA
SYSTEME TECHNIQUE	Domaine de conception technique du SYSTEME
STRA	Domaine d'emploi du STRA

La description de l'ODD est une tâche à réaliser dans le cadre de la spécification du système de conduite automatisé ou du système de transport routier automatisé, comme l'indique la figure ci-dessous à titre d'illustration.

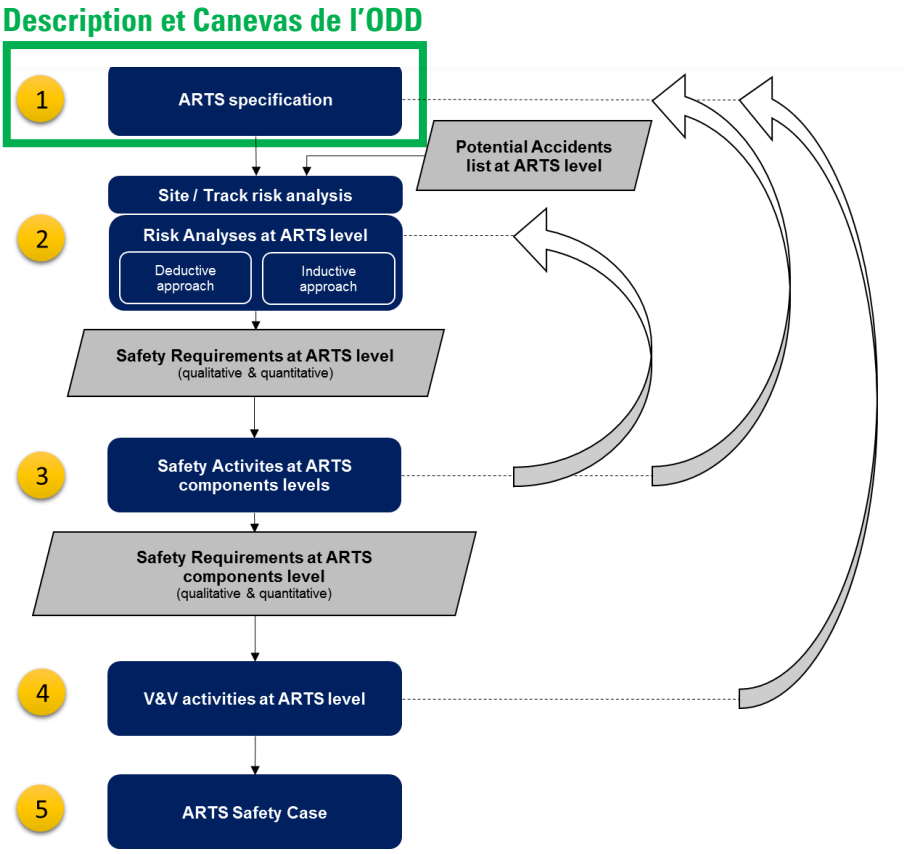

Figure 1 *- Représentation simplifiée du processus de démonstration de la sécurité SAM pour un STRA*

L'ODD est l'un des éléments que présenteront les industriels au service en charge de la réception ou de l'homologation des systèmes de conduite automatisés ou d'autorisation de mise en service des systèmes de transport routiers automatisés (STRA), dans les dossiers de sécurité réglementaires.

Pour faire simple avant d'en donner une définition plus précise, l'ODD, regroupe l'ensemble des caractéristiques et limites du domaine de bon fonctionnement pour lesquelles le système a été conçu. Pour garantir le fonctionnement du système en toute sécurité, il ne doit être utilisé nominalement que dans son ODD. L'ODD doit être décrit de manière précise et commune pour être partagée aux différentes parties prenantes concernées par le système sur tout son cycle de vie.

Cette description de l'ODD sera intégrée au dossier d'information sur la conception du système remis aux autorités qui vérifieront lors de l'homologation ou la certification « si le système […] a été conçu et élaboré pour fonctionner de manière à être exempt de risques déraisonnables pour le conducteur, les passagers et les autres usagers de la route à l'intérieur du domaine de conception fonctionnelle et des limites déclarées » (cf. Réglementation R157 [5] dite « ALKS »).

Ce livrable se fonde sur une position technique PFA [17], initialement proposée par les industriels de l'automobile pour répondre à la réglementation R157 « dite, ALKS » autorisant à partir de 2021 la circulation des véhicules munis de systèmes de conduite automatisée (de niveau 2+ ou de niveau 3) en bouchons sur voie à chaussées séparées.

Cette position PFA a notamment été présentée dans le cadre de l'écriture de la norme ISO 34503, qui vise à normaliser la description de l'ODD. Cette première proposition a permis dans le cadre du projet SAM d'obtenir un consensus entre les partenaires, et de proposer pour ce livrable une position commune. Ce sera désormais la version présentée dans le cadre des groupes de travail de l'administration (comme précisé dans le livrable [18]) et dans le cadre de la normalisation ISO.

Ce livrable comprend : un état de l'art concernant l'ODD, la définition retenue de l'ODD, sa structuration ainsi que la définition des catégories et attributs de l'ODD. Enfin, ce document propose un canevas de description de l'ODD dans l'outil Excel, présenté en annexe, et joint à ce livrable.

○

La suite du document sera principalement en anglais afin qu'il puisse servir directement dans le cadre de discussions internationales au niveau réglementaire, normatif, ou bilatéral, mais aussi pour éviter des ambiguïtés liées au fait d'avoir deux définitions en deux langues différentes avec les interminables écarts de sens des mots. Les parties concernant les textes législatifs français seront quant à eux, en français exclusivement. Veuillez nous en excuser.

○

The ODD shall be defined. Whatever the ODD, it has to be described with a common hierarchy and taxonomy. A system SAE L3 or higher shall be designed to be only used inside the ODD – by considering to avoid unreasonable risks. These systems must be designed to consider situations that can be expected, address possible risks and detect its ODD limits.

This document gives the positions of ADS Safety & Validation working group of SAM project. After setting the state of the art concerning ODD, and giving the definition of an ODD, the ODD structuration is described, and categories and attributes are defined and named. The part concerning french legal framework for Automated Road Transport Systems is in French only to avoid translation interpretation. Sorry for the inconvenience. The position also proposes a template document in excel in order to describe the ODD.

1. Etat de l'art - State of the art

Several definitions from Operational (Design) Domain were given in regulation, SAE, or NHTSA documents. After presenting this state of the art, we will choose our position. At the beginning of this document please note that Operation Domain (OD) or Operational Design Domain (ODD) are both used in a very similar way. At first sight, ODD seems more US native and OD European native.

Source	***ODD relative items***
CAMP March 2016 *[11]*	*The specific operating conditions (e.g., geographic, weather, time of day, road type) under which a given driving automation system, or feature thereof, is designed to function.*
US DOT September 2016 *[10]*	*Description of the specific Operating Domain(s) in which an automated function or system is designed to properly operate, including but not limited to roadway types, speed range, environmental conditions (weather, daytime/nighttime, etc.) and other domain constraints.* *The manufacturer or other entity should define and document the Operational Design Domain (ODD) for each HAV system available on their vehicle as tested or deployed for use on public roadways.32 The ODD should describe the specific operating domain(s) in which the HAV system is designed to properly operate. The defined ODD should include the following information to define HAV systems' capabilities:* - *Roadway types on which the HAV system is intended to operate safely;* - *Geographic area;* - *Speed range;* - *Environmental conditions in which the HAV will operate (weather, daytime/nighttime, etc.); and* - *Other domain constraints.* *Manufacturers and other entities should develop tests and verification methods to assess their HAV systems' capabilities to ensure a high level of safety. In the future, as DOT develops more experience and expertise with HAV systems, NHTSA may promulgate specific performance tests and standards. Presently, manufacturers and other entities should develop and apply tests and standards to establish the safe ODD for each HAV system. An HAV should be able to operate safely within the ODD for which it is designed. In situations where the HAV is outside of its defined ODD or in which conditions dynamically change to fall outside of the HAV's ODD, the vehicle should transition to a minimal risk condition. The vehicle should give a clear indication of the type outlined in the HMI section to the occupants that it is switching to a minimal risk condition and that the HAV system is not available.* *To better inform human drivers and vehicle operators, the ODD should also be described in summary form and in plain language in the vehicle owner's manual, including a clear description of the conditions in which the vehicle's HAV system(s) is and is not intended to operate. These instructions should aid the human driver or operator of the vehicle to easily understand the capabilities and limitations of each HAV system.*
NHTSA Sept 2017 ***[7]***	*Entities are encouraged to define and document the Operational Design Domain (ODD) for each ADS available on their vehicle(s) as tested or deployed for use on public roadways, as well as document the process and procedure for assessment, testing, and validation of ADS functionality with the prescribed ODD. The ODD should describe the specific conditions under which a given ADS or feature is intended to function. The ODD is the definition of* ***where*** *(such as what roadway types and speeds) and* ***when*** *(under what conditions, such as day/night, weather limits, etc.) an ADS is designed to operate.* *The ODD would include the following information at a minimum to define each ADS's capability limits/boundaries:* • *Roadway types (interstate, local, etc.) on which the ADS is intended to operate safely;* • *Geographic area (city, mountain, desert, etc.);*

	• *Speed range;* • *Environmental conditions in which the ADS will operate (weather, daytime/nighttime, etc.); and* • *Other domain constraints.* *An ADS should be able to operate safely within the ODD for which it is designed. In situations where the ADS is outside of its defined ODD or in which conditions dynamically change to fall outside of the ADS's ODD, the vehicle should transition to a minimal risk condition.* *For a Level 3 ADS, transitioning to a minimal risk condition could entail transitioning control to a receptive, fallback-ready user.* *In cases the ADS does not have indications that the user is receptive and fallback-ready, the system should continue to mitigate manageable risks, which may include slowing the vehicle down or bringing the vehicle to a safe stop. To support the safe introduction of ADSs on public roadways and to speed deployment, the ODD concept provides the flexibility for entities to initially limit the complexity of broader driving challenges in a confined ODD.*
ISO 22736 ***SAE J3016*** *2018, June* *[8]*	*Operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.* *The ODD information shall include at least data on:* • *roadway types,* • *geographic area,* • *vehicle speed range,* • *environmental conditions, and* • *other restrictions* *NOTE: Section 6 discusses the significance of ODDs in the context of the Levels of driving automation.* *EXAMPLE 1: An ADS feature is designed to operate a vehicle only on fully access-controlled freeways in low-speed traffic, under fair weather conditions and optimal road maintenance conditions (e.g., good lane markings and not under construction).* *EXAMPLE 2: An ADS-dedicated vehicle is designed to operate only within a geographically defined military base, and only during daylight at speeds not to exceed 25 mph.* *EXAMPLE 3: An ADS-dedicated commercial truck is designed to pick up parts from a geo-fenced seaport and deliver them via a specific route to a distribution center located 30 miles away. The vehicle's ODD is limited to day- time operation within the specified seaport and the specific roads that constitute the prescribed route between the seaport and the distribution center.*
WP.29 ***June 2019*** ***[4]***	*For the assessment of the vehicle safety, the vehicle manufacturers should document the [ODD/OD] available on their vehicles and the functionality of the vehicle within the prescribed [ODD/OD].* *The [ODD/OD] should describe the specific conditions under which the automated vehicle is intended to drive in the automated mode.* *The [ODD/OD] should include the following information at a minimum: roadway types; geographic area; speed range; environmental conditions (weather as well as day/nighttime); and other domain constraints.*
BMW ***2019, June*** ***[12]***	*Another driving force behind the requirements on the system for higher levels of automation originate in the definition of the operational design domain (ODD). As previously mentioned, the ODD as defined by SAE J3016 is the collection of conditions where the system is designed to operate. Examples can be geographic as in the country or state, environmental as from sunshine to snow, or a collection of roadway characteristics such as a divided highway. As the function is designed to operate safely in this domain, sensors shall confirm at all times that the vehicle is still in that domain.* ***ODD recognition*** *As soon as system limits, which restrict the safe functionality of the automation system, are recognized, the system must react to compensate, or request a take-over from the driver with adequate time reserve.*

	Since the automated driving system is limited to an ODD and while activated in this domain, it is responsible for vehicle control until it requests the fallback ready user to intervene. While this may sound trivial, in lower levels of automation, it is ultimately the driver's responsibility to recognize when the limits are reached. The system may provide assistance to that effect, but only higher levels of automation need to definitively register the limits as a reaction is necessary. ***Manage typical situations*** *The automated driving system must take situations into account, which can typically be expected to be encountered in the ODD and address the risks that may result.* *The sensor arrays of vehicles equipped with automated driving systems need to register and classify much more than only the most common objects and the situations they are associated with. Even when they only make up a small percentage of the time spent on the road, there are a multitude of events such as an unexpected lane change, which happen often enough that they cannot be considered unusual. The system shall therefore be able to deal with all situations that are foreseeable to occur within the ODD which have an inherent risk of relevant magnitude.*
SaFAD *2019, July* *[6]*	***ODD DETERMINATION*** *As soon as system limits that restrict the safe functionality of the automated system are recognized, the system shall react to compensate or shall issue a driver takeover request with a sufficient time frame for the takeover.* ***MANAGE TYPICAL SITUATIONS*** *The automated driving system shall take into account situations that can typically be expected in the ODD and address possible risks.* ***[SAE J3016]:*** *The ODD refers to the operating conditions under which a given automated driving system or feature thereof is specifically designed to function. "These limitations reflect the technological capability of the automated driving system."*
Thatcham Research *Sept 2019* *[13]*	***ODD:*** *which a given ADS is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.* ***Driving Domain:*** *A high level set of four categories of ODD, representing the classes of driving situation the ADS is intended to function: Parking, City, Inter Urban or Highway.* ***Location Specific: Operational Design Domain (ODD)*** ➢ ***Technical requirements:*** *The manufacturer of an ADS shall publish a detailed definition of the ODD in which the ADS will function safely. Road type is one of the main criteria that must be defined. Any ADS that operates in the 'Highway' driving domain shall be subject to the requirements in this document.* *The ODD requirements shall be a combination of static (fixed, such as Highway) and dynamic features (changing, such as Traffic conditions).* *As a minimum, manufacturers shall include specific information on whether or not there are any further restrictions in the ODD in terms of:* • *Junctions* • *Geography* • *Speed range* • *Road conditions* • *Traffic conditions* • *Environmental conditions.* ➢ ***Test and Assessment*** *The manufacturer shall demonstrate through virtual testing how the ADS will identify that it is within the ODD, and how it will reliably predict when it will leave the ODD with sufficient notice to allow managed handback. The type approval authority will check the results of the virtual testing during the on-road trial*

	by placing the vehicle in a range of situations both outside, entering, within and exiting the ODD to assess whether the system reliably indicates its availability.
UL 4600 *2019, December* *[16]*	*The set of environments and situations the item is intended to operate within. This includes not only direct environmental conditions and geographic restrictions, but also a characterization of the set of objects, events, and other conditions that will occur within that environment.* *NOTE: A system has a single ODD by definition. Assessment is made with regard to the entire ODD.* *See also: ODD Subset* ***ODD Subset:*** *A managed portion of an item's ODD.* *EXAMPLE: An all-weather ODD is broken up into subsets for fair weather, rain, and snow/ice.* *NOTE: An ODD subset might be defined to partition the operational space to ease design tasks, support phased deployment by adding additional subsets over time, or otherwise manage the complexity of a potentially large and varied ODD. The safety case might argue each ODD subset independently for some aspects*
PFA/DGITM *Jan. 2020* *[15]*	***ODD description:*** *ODD description could take into account the following parameters:* • *Type of infrastructure* • *Hours / period* • *Visibility conditions* • *Surface conditions* • *Contextual speed and traffic conditions* • *Eligible lanes (position, min-max width, lane merges, incoming ramps, exits)* • *Eligibility of specific sections or zones under autonomous mode* ***High Level Rule (ODD):*** *The vehicle shall not be in AD mode out of its ODD.*
GRVA(ALKS) *March 2020* *[5]*	***Operational Design Domain (ODD)*** *of the automated lane keeping system defines the specific operating conditions (e.g. environmental, geographic, time-of-day, traffic, infrastructure, speed range, weather and other conditions) within the boundaries fixed by this regulation under which the automated lane keeping system is designed to operate without any intervention by the driver.* - *The System is designed and was developed to operate in such a way that it is free from unreasonable risks for the driver, passengers and other road users within the declared ODD and boundaries;* - *Interaction concept with the driver when ODD limits are reached shall be explained including the list of types of situations in which the system will generate a transition demand to the driver.* - *Model of the information provided to users (including expected driver's tasks within the ODD and when going out of the ODD.*
Ongoing work at ISO	
ISO/TS 14812 ***2019 (CD Stage)*** *2019* *[9]*	*Set of operating conditions under which a given driving automation system or feature thereof is specifically designed to function* *EXAMPLE 1ADS feature designed to operate a vehicle only on fully access-controlled freeways in low-speed traffic, under fair weather conditions and optimal road maintenance conditions (e.g., good lane markings and not under construction).* *EXAMPLE 2ADS-dedicated vehicle designed to operate only within a geographically defined area, and only during daylight at speeds not to exceed 25 mph.*

	Note 1 to entry: The conditions might include environmental, geographical, time-of-day, and/or other restrictions. *Note 2 to entry: The conditions might require the presence or absence of certain traffic or roadway characteristics.*
ISO 22734 ***TC204/WG 14*** *[14]*	*Every LSAD system shall have its ODD defined by the manufacturer. The operational design domain limits for LSAD system shall specify at least the following attributes:* ➢ *Low speed – speed of LSAD system shall be equal to or less than 8.89 m/s or 32 km/h.* ➢ *Areas of application – e.g. either restricted access or dedicated roadways (public or private), or pedestrian / bicycle pathways, or areas from which all or some specific categories of motor vehicles are restricted. Restricted access roadways may be specified by lane markings or speed restriction or physical demarcation.* ➢ *Pre-defined routes – Routes defined within the LSAD system before operation of the LSAD system.* *LSAD system shall only operate on the pre-defined routes. Pre-defined routes shall be defined by relevant stakeholders in conjunction with each other (e.g. local authorities, service providers, manufacturers etc.). Any deviation from pre-defined routes shall be confirmed by remote dispatcher (if applicable).* • *Lighting condition in the area of application* • *Weather conditions* • *Road conditions* • *Presence or Absence of Vulnerable Road Users (VRUs)* • *Connectivity requirements* *Either the LSAD systems or the dispatcher should select LSAD system equipped vehicle operating values for the ODD attributes based on current ODD conditions (e.g. foggy weather conditions, nighttime lighting condition).* *NOTE: For example, a dispatcher or LSAD system may decide to restrict the maximum allowable speed on a rainy day to a lower speed as compared to a clear sunny day.*
DGITM ***[19]***	*Methodological document introducing the ODD description and attributes* *L'objectif du présent document est de proposer des principes de définition de l'« operational design domain » (ODD) s'appuyant sur les travaux existants et tenant compte des différents cadres d'application dans lequel ce concept, fondateur mais large, est utilisé.* *Le présent document méthodologique fait état des différentes approches de description des ODD proposées dans les travaux internationaux et tente de faire émerger des propositions d'ordonnancement des attributs qui ressortent de ces travaux. A ce stade préliminaire, les attributs ne sont pas figés, ni exhaustifs et la classification proposée a vocation à être consultative et à évoluer compte-tenu de l'approfondissement des travaux internationaux et avec l'éco-système français.*
ISO 34503 ***[18]***	*ISO International Standard in the TC 22 SC 33 : Vehicle dynamics, chassis components and driving automation systems testing, in the Working Group 9, dedicated to Test Scenarios and ODD. Main sources of this document are NHTSA previous document, and BSI 1880 on ODD.* *This document specifies the requirements for the hierarchical taxonomy for specifying operating conditions which enable the definition of an operational design domain (ODD) of an automated driving system (ADS). At the top level, there are only 3 categories, like in the BSI 1880, i.e.: Scenery - Dynamic element - Environmental conditions. This document also specifies requirements for the definition format of an ODD using the taxonomy. The ODD comprises specific conditions (which include the static and dynamic attributes) within which an ADS is designed to function. ADS shall perceive the operating environment, i.e. shall be aware of the near real-time ODD attributes' values, so that the ADS can compare the external conditions (i.e. the COD) with the defined ODD.* *ANNEXE 3 is dedicated to ISO 34503 key requirements.* *SAM project members participated to the elaboration of this standard, based on the first version of the present deliverable.*

Now that state of the art of the definition of the ODD is explored and set, let's now define SAM partners position.

2. Définition de l'ODD - ODD definition

We consider as a reference, ISO / SAE J3016 [8] definition of the ODD, because of the largest consensus, and largest usage (not only level 3 and more automated driving systems like in Regulation document):

***OPERATIONAL DESIGN DOMAIN**, hereafter ODD, is first defined as: "Operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics."*

*NOTE : **For system, ALKS** regulation [5] proposes the following specific version: "Operational Design Domain (ODD) of the automated lane keeping system defines the specific operating conditions (e.g. environmental, geographic, time-of-day, traffic, infrastructure, speed range, weather and other conditions) within the boundaries fixed by this regulation under which the automated lane keeping system is designed to operate without any intervention by the driver."*
It is important to consider that regulation fixes specific constraints that could be considered as boundaries but that ODD definition remains on OEM responsibility, inside these regulation boundaries.

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Nous proposons par convention de retenir l'acronyme ODD, pour Domaine de Conception Fonctionnelle, terme retenu par la traduction en français de la réglementation ALKS [5] et dans la loi française dite LOM.

La traduction de la définition générique donnée par l'ISO / SAE J3016 [8] **quel que soit le niveau de délégation de conduite** devient :

Domaine de conception fonctionnelle (ODD) : conditions d'opération dans lesquelles un système de conduite automatisée donné ou une fonction de celui-ci est spécifiquement conçu pour fonctionner. Elles comprennent au-minimum les conditions environnementales et géographiques, des restrictions temporelles, et la présence ou l'absence de certaines caractéristiques routière ou du trafic.

L'application de cette définition au système de délégation de conduite en embouteillage sur voies à chaussées séparées (de niveau 2+ ou 3) définit par la Réglementation ALKS [5] est :

Domaine de conception fonctionnelle (ODD) du système automatisé de maintien dans la voie, les conditions de fonctionnement spécifiques (par exemple, les conditions environnementales, géographiques ou météorologiques, l'heure, la circulation, l'infrastructure, la plage de vitesses, et autres) dans les limites fixées par le présent Règlement, dans lesquelles le système automatisé de maintien dans la voie est conçu pour fonctionner sans aucune intervention du conducteur ; (cf. R157 [5] – Annexe 4 - § 2.9)

Enfin, une troisième définition a été retenue dans le cadre de l'écriture de la Loi d'Orientation des Mobilités, dite loi LOM. Elle couvre aussi bien les systèmes de délégation de conduite de niveau 3 ou de niveau 4 intégrés à des systèmes de transport routier automatisés, et définit une liste minimale et non exhaustive des attributs du domaine :

Domaine De conception fonctionnelle (ODD) : Conditions notamment géographiques, météorologiques, horaires, de circulation, de trafic et d'infrastructure dans lesquelles un système de conduite automatisé est spécifiquement conçu pour exercer le contrôle dynamique du véhicule et en informer le conducteur.
(cf. LOM – Article 31 -Projet de Décret - Volet relatif aux définitions version du 02-12-2020)

Au final, la description de l'ODD synthétise les conditions d'opération en sécurité du système étudié. Chacun des attributs de l'ODD est un élément à percevoir, considérer, connaître par le système pour identifier que le véhicule automatisé :

- Est dans son ODD
    - e.g : le système est opérationnel sur autoroute
    - on dit alors que l'attribut (e.g. autoroute) est INCLUS dans l'ODD.
- Va franchir une limite de l'ODD
    - e.g: le système est opérationnel et approche d'un tunnel dans lequel il n'est pas prévu pour fonctionner
    - on dit que l'attribut auquel le système sera bientôt confronté (e.g. tunnel ~~panneau fin d'autoroute~~) est EXCLUS de l'ODD. Il est nécessaire de définir l'anticipation avec laquelle le système devra prendre en compte cet attribut pour mettre en œuvre la reprise en main ou la MRM appropriée.
- Est hors de l'ODD
    - e.g : le véhicule est sur voie bidirectionnelle à chaussées non séparée
    - on dit que l'attribut est EXCLUS de l'ODD

C'est pourquoi, il est tant important de standardiser autant que possible la hiérarchie de description des ODD, ainsi que leurs attributs. C'est l'objet de la partie suivante.

Nota Bene : Il est très important de toujours garder en mémoire que la description de l'ODD en tant que document de synthèse, contient l'ensemble des conditions d'opération en sécurité du système étudié. Chaque condition est donnée par le fait qu'un « attribut » est INCLUS ou EXLUS de l'ODD.

3. Attributs de l'ODD - ODD attributes

The five main documents on the topic are from NHTSA [1], GRVA [4], ISO 34503[18], DGITM[19], and SAE [8]. SAM project considers as the reference for a minimum description, the Regulation [5] version, with only five items:

The ODD shall include the following information at a minimum to comply with ALKS Regulation:
- Road types,
- Speed range,
- Geographic area,
- Environmental condition (weather as well as day/night-time),
- And other domain constraints

Moreover, SAM project considers, as proposed by NHTSA [1], that it is necessary to give more details about the Operational Design Domain of the system:

SAM project proposes, in order to simplify the understanding of ODD description, to always organize ODD description with the same high-level **architecture**, and **taxonomy**, to produce more information (regulatory information is in bold/grey). An ODD consists in items. Each item is called an **Attribute**. Attributes are gathered in 6 high-level **categories**.

For each of the 6 categories, we give an explanation directly extracted from NHTSA [1]:

1. Physical infrastructure

"Physical infrastructure is typically characterized by technical structures, such as roads, bridges, tunnels, etc. ADS features may depend on such infrastructure elements, which are a critical part of the ODD environment." (NB: it includes: **Roadway types** (Necessary to comply with regulation).

2. Operational constraints

Several operational constraints "*need to be considered when designing and testing ADS applications. These include elements such as dynamic changes in speed limits, traffic characteristics, construction, etc. For example, an ADS entering a school zone is subjected to lower speed limits and must respond appropriately to ensure the safety of its* passengers and other road users". (NB: it includes: Speed limit = **Speed range,** necessary to comply with regulation).

3. Objects

"*For an ADS to properly navigate within an ODD, it must detect and respond to certain objects, which is referred to as OEDR.*" OEDR is another topic "*but is discussed here in the context of identifying objects that can reasonably be expected to exist within the ODD. For example, a pedestrian may be expected at an intersection but rarely on a freeway."*

4. Connectivity

"Connectivity is an enabling technology that may define where an ADS feature can operate. For example, low-speed shuttles may depend on traffic light signal phase and timing messages to reduce the dependence on sensors alone to detect the signal. […] Connectivity constitutes a communications link between other vehicles, road users, remote fleet management operators, and physical and digital infrastructure elements."

5. Environmental conditions

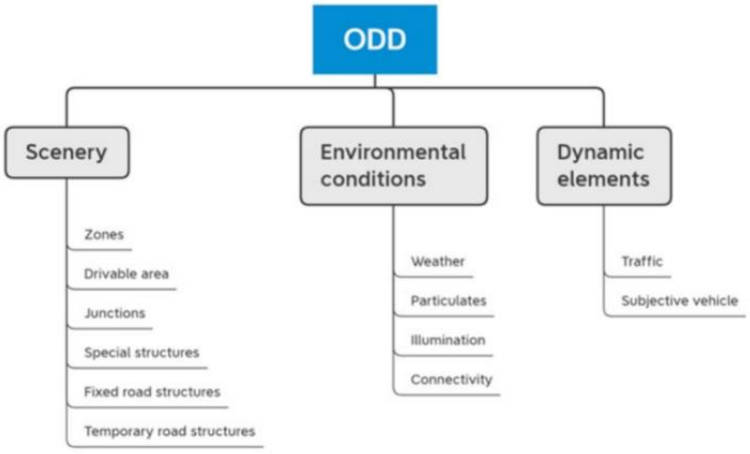
(Necessary to comply with regulation) : *"Environmental conditions play a crucial role in the safe operation of a variety of ADS applications, and pose one of the biggest challenges to deployment, particularly early deployment. The environment can impact visibility, sensor fidelity, vehicle maneuverability, and communications systems. […] It is thus important to consider a variety of environmental conditions as part of the ODD."*

6. Zones

(= **Geographic area**, Necessary to comply with regulation) : *"ADS features may be limited spatially by zones. The boundaries of these zones may be fixed or dynamic, and conditions that define a boundary may be based on complexity, operating procedures, or other factors. One example is work zones, which can confuse ADS as the road configuration (pavement markings and new lane alignments) differs from typical conditions. In a work zone, cones may replace double yellow lines, and construction worker hand signals may overrule traffic lights."*

7. Correspondances avec les catégories de ISO 34503 – Consistency with ISO 34503 categories

Nota Bene: As already mentioned, the ISO 34503 about ODD, is mainly based on the NHTSA document for hierarchy, but gathers the 6 categories only in 3 at high level, as shown in the following figure:



- Connectivity, is included in Environmental conditions.
- Zones, is included in Scenery with Road Infrastructure
- Objects are split in Scenery for the static elements, and in Dynamic element when they can move.

This high-level hierarchy from ISO 34503 even if normative, is very similar, so it is easy to explain that the content is completely align, that's why we propose to keep NHTSA's, 6 top level categories.

8. Catégories détaillées – detailed categories

The next part of this chapter gives more detail information on each of the previous six categories and associated sub-categories. **This list of ODD elements is not exhaustive, but it gives a structure of description of the ODD, and the associated taxonomy.** You should use it to describe in your ODD all the necessary items to define what is within and what is outside an ODD and what it should detect. The following hierarchy, is the more detail one, given in NHTSA [1] (for more information please refer to this reference document), and this is considered as the reference on the topic. All items are not mandatory to be defined, but as said before, this hierarchy allows to define and organize the different items an gives the taxonomy to be used.

1. Physical infrastructure

1.1. Roadway types
For example: divided highway, undivided highway, Arterial, urban, rural, parking, …
1.2. Roadway surfaces
For example: asphalt, concrete, mixed, grating, brick, dirt, gravel, scraped road, speed bumps, potholes, grass, …
1.3. Roadway Edges
For example: line markers, temporary line markers, shoulder (paved, gravel or grass), concrete barriers, grating, rails, curb, cones, …
1.4. Lane markings
For example: lane markings, temporary lane markings, zebra, …
1.5. Roadway Geometry
For example: straightaways, curves, hills, lateral crests, corners (regular, blind corners), negative obstacles, lane width, …

2. Operational constraints

2.1. Speed limit
For example: Minimum and maximum speed limit, speed limit depending on environmental conditions, …
2.2. Traffic Conditions
For example: minimal traffic, normal traffic, aumper-to-bumper/rush-hour traffic, altered (accident, emergency vehicle, construction, closed road, special event), …
2.3. Operational conditions
For example: Max passenger capacity, max payload, maximum number of vehicle per site, …
2.4. Driver and operator conditions
For example: present in seat, attentive, …

3. Objects

3.1. Passive vertical signage
For example: signs (e.g., stop, yield, pedestrian, railroad, school zone, etc.), traffic signals (flashing, school zone, fire department zone, etc.), …

3.2. Dynamic signage
For example: dynamic speed limit, dynamic traffic signs, …

3.3. Roadway users
For example: vehicle types (cars, light trucks, large trucks, buses, motorcycles, wide-load, emergency vehicles, construction equipment, horse-drawn carriages/buggies), …

3.4. Non roadway users & obstacles
For example: animals (e.g., dogs, deer, etc.), shopping carts, debris (e.g., pieces of tire, trash, ladders), …

3.5. Human signs
For example: human directed traffic, human injunction, …

4. Connectivity

4.1. Vehicles
For example: V2V communications (e.g., DSRC, Wi-Fi), emergency vehicles, …

4.2. Remote Fleet Management System
For example: a vehicle may be supported by an operations center that can perform remote operation, …

4.3. Infrastructure sensors
For example: VRU detection, work zone alerts, routing and incident management, …

4.4. Digital infrastructure
For example: Map, GNSS, traffic density information, …

5. Environmental conditions

5.1. Weather
For example: wind, rain, snow, sleet, temperature, …

5.2. Weather induced roadway conditions
Standing water, flooded roadways, icy roads, snow on road, …

5.3. Particulate matter
For example: fog, smoke, smog, dust/dirt, mud, water projection, …

5.4. Illumination
For example: day (sun: overhead, back-lighting, and front-lighting), …

5.5. Time of the day
For example: available from 9 Am until 10 Pm, …

6. Zones

6.1. Geofence area,
For example: central business districts, school campuses, and retirement communities, …

6.2. Region/states
For example: any legal, regulatory, enforcement, tort, or other considerations (e.g., following distance, licensing, etc.), …

6.3. Interference zones
For example: tunnel, parking garages, Bridge, buildings, dense foliage, atmospheric conditions, …

4. Exigences sur l'ODD - ODD relative requirements

From the basis of the state of the art produced in Part 1, SAM project opinion is to consider the following requirements to be satisfied.

1. Exigences de la réglementation ALKS – ALKS regulation Requirements

From ALKS regulation [5] the requirements considered are:

1. "The ODD should describe the specific conditions under which the automated vehicle is intended to drive in the automated mode."
2. "The vehicle manufactures should document the ODD available"
3. "The ODD should include the following information at a minimum: roadway types; geographic area; speed range; environmental conditions (weather as well as day/nighttime); and other domain constraints."
4. "The System is designed and was developed to operate in such a way that it is free from unreasonable risks for the driver, passengers and other road users within the declared ODD and boundaries;"
5. "The interaction concept with the driver when ODD limits are reached shall be explained including the list of types of situations in which the system will generate a transition demand to the driver."
6. "Model of the information provided to users (including expected driver's tasks within the ODD and when going out of the ODD."

2. Exigences issus d'autres standards – Other standards requirements

From other kinds of documents, we only consider PFA Safety position paper [3] and NHTSA documents [1] which allow to synthetize the following requirements:

a) ODD01 – The vehicle shall not be in AD mode out of its ODD.
b) ODD02 – Manufacturers and other entities [like Mobility services providers] should develop and apply tests and standards to establish the safe ODD.
c) ODD03 – In situations where the ADS is outside of its defined ODD or in which conditions dynamically change to fall outside of the ADS's ODD, the vehicle should transition to a minimal risk condition. (For a Level 3 ADS, transitioning to a minimal risk condition could entail transitioning control to a receptive, fallback-ready user.)
d) ODD04 – The manufacturer shall demonstrate how the ADS will identify that it is within the ODD, and how it will reliably predict when it will leave the ODD.
e) ODD05 – To better inform human drivers and vehicle operators, the ODD should also be described in summary form and in plain language in the vehicle owner's manual, including a clear description of the conditions in which the vehicle's AD system(s) is and is not intended to operate.
f) ODD06 – The driver/operator shall be informed about when the system will reach a limit of the ODD, whatever the minimal risk condition (vehicle stop or driver take back control…).

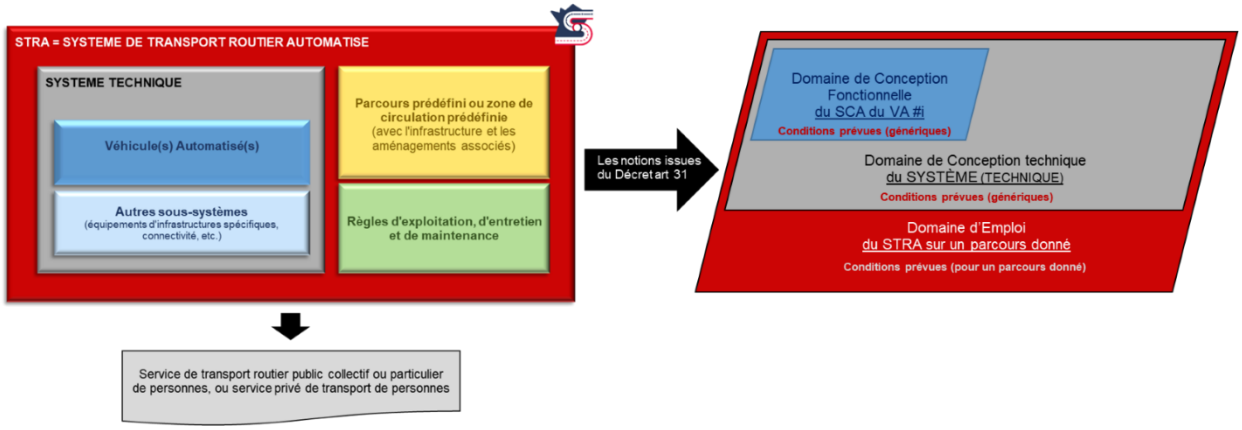
3. Exigences de la loi LOM – French law LOM requirements

Le périmètre d'application de la loi LOM étant plus large que le système de conduite automatisée, puisqu'elle s'applique à tout système de transport routier automatisé, des premières définitions issues de cette loi doivent être données :

Art. R. 3151-1. *– Pour l'application du présent livre, les termes ci-après ont le sens qui leur est donné dans le présent article :*

*1. « **système technique de transport routier automatisé** » : ensemble de véhicules hautement et totalement automatisés tels que définis au 8.2 et au 8.3 de l'article 311-1 du code de la route et d'installations techniques permettant une intervention à distance ou participant à la sécurité ;*
*2. « **système de transport routier automatisé** » : système technique de transport routier automatisé, déployé sur des parcours ou zones de circulation prédéfinis, et complété de règles d'exploitation, d'entretien et de maintenance, aux fins de fournir un service de transport routier public collectif ou particulier de personnes, ou de service privé de transport de personnes, à l'exclusion des transports soumis au décret n° 2017-440 du 30 mars 2017 relatif à la sécurité des transports publics guidés ;*
*3. « **domaine d'emploi** » : conditions d'emploi d'un système technique de transport routier automatisé associées à des parcours ou zones de circulation particulières et respectant son domaine de conception technique ;*
*4. « **domaine de conception technique du système** » : conditions d'opération dans lesquelles un système technique de transport routier automatisé est spécifiquement conçu pour fonctionner.*

C'est ce qu'illustre la figure suivante :



Maintenant que les termes sont bien définis, voici les extraits des articles concernant ces différents domaines :

Art. R. 319-1. – I. Pour l'application du premier alinéa de l'article L. 319-1, le système de conduite automatisé est soumis à des conditions d'utilisation qui précisent notamment :
1° Le domaine de conception fonctionnelle et ses limites, notamment concernant les interactions avec les forces de l'ordre et les véhicules d'intérêt général prioritaires ou bénéficiant de facilités de passage ;

Art. R. 3152-2. _ II. - Tout système de transport routier automatisé doit :
1° Etre conçu pour éviter les accidents pouvant résulter de situations raisonnablement prévisibles dans son domaine d'emploi ;
2° Reconnaître s'il est dans son domaine d'emploi et n'être actif que dans ce domaine d'emploi ;
3° Détecter ses défaillances ainsi que la sortie du domaine d'emploi et en informer l'exploitant, y compris dans le cadre d'une intervention à distance.

Art. R. 3152-2. _ III. - Tout système technique de transport routier automatisé doit :
1° Etre conçu pour éviter les accidents pouvant résulter de situations raisonnablement prévisibles dans son domaine de conception technique du système ;

2° Utiliser des véhicules équipés d'un système de conduite automatisé conçu pour exécuter des manœuvres à risque minimal ou d'urgence ;
3° Etre en mesure de détecter ses défaillances ainsi que la sortie du domaine de conception technique du système, et d'en informer l'exploitant y compris dans le cadre d'une intervention à distance.

Les figures suivantes illustrent la distinction de ces notions par périmètre technique adressé :

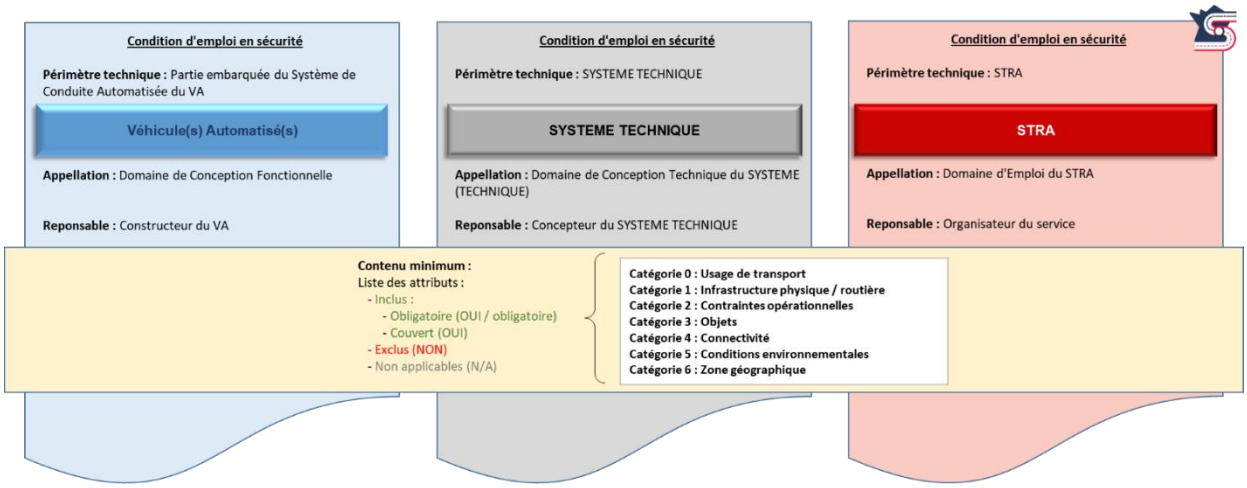


Figure 12 : Illustration de la distinction des notions de conditions d'emploi en sécurité par périmètre technique.

Conclusion

Le domaine de conception fonctionnelle, ou l'ODD a été défini dans plusieurs documents normatifs et réglementaires. Nous considérons comme référence valable quelle que soit le niveau de délégation de conduite, la définition issue de l'ISO / SAE J3016 [8], en raison du plus large consensus et de la plus grande utilisation de cette référence.

Cette définition et cette description de l'ODD s'appuient sur les documents de l'état de l'art (NHTSA et ISO 34503). Les éléments à vocation de standard sont les 6 catégories de premier niveau, les attributs de second niveau, ainsi que les noms associés. Il faut noter que la première version de ce livrable SAM a été présenté à l'ISO dans le groupe de travail de rédaction de la norme 34503 afin d'apporter la position française, et a été présenté à l'administration lorsqu'elle voulait établir la doctrine française sur l'ODD, et surtout lorsqu'elle a voulu définir des descripteurs (attributs) « français » de l'ODD.

Lors de la phase de validation par les partenaires de la conformité des livrables à leurs attentes, les représentants de l'UTAC ont confirmé que cette description de l'ODD correspondait à leurs attentes dans le cadre de la réglementation UN R157 (ALKS).

ANNEXE : ISO 34503

La présente annexe regroupe l'ensemble des exigences exprimées dans la norme ISO 34503 [18]. Elles sont repérées grâce au verbe **SHALL** qui est employé.

- **§6 - ODD & scenarios**
  - The ODD definition shall be used as one of the inputs for scenario-based safety evaluation framework in accordance with ISO 34502. Also, a comparison between a test scenario set and the ODD definition shall be performed to analyse the test space coverage.

- **§7 - ODD requirements**
  - an ODD definition shall be developed by an ADS developer and before deployment should be compared with the stakeholders' requirements of the operational domain (OD), either individually or in consultation, for the safe operation of the ADS in the operating domain
  - The abstraction hierarchy to be used for the ODD definition, see Clauses 8 to 11, shall be at the discretion of the stakeholder.
  - Irrespective of the abstraction level chosen, stakeholders shall specify the ODD attributes used to inform the scenario-based testing of the ADS.
  - Defines an ODD choosing an attribute at a higher abstraction level shall ensure that all the predefined subattributes are also within the ODD definition,
  - While performing the DDT, ADS shall perceive the operating environment, i.e. shall be aware of the near real-time ODD attributes' values, so that the ADS can compare the external conditions (i.e. the COD) with the defined ODD.
  - ODD attributes may have interdependence and their relationship shall be defined in a prescribed format (Clause 12).
  - ODD attributes shall be defined in such a way to allow the ADS to be aware if it remains within the designed and defined ODD attribute definition. The ODD monitoring is needed for forecasting an upcoming ODD boundary with sufficient time buffer.
  - Test scenarios shall be identified according to the constraints given by the ODD definition. As part of the process to show compliance with the defined ODD, test procedures shall be demonstrated for the specific defined ODD attributes.
  -
- **§8 - ODD Taxonomy**
  - For all attributes, the specifier shall provide the objective measurement for the attribute.
  - At the top level, the ODD shall be classified into the following attributes:
    - scenery elements;
    - environmental conditions;
    - dynamic elements.
  - The "scenery elements" attribute (in the context of defining an ODD) shall consist of the spatially fixed elements of the operating environment (e.g. roads, traffic lights, etc.), relative to the ego vehicle (in terms of position of the elements).
  - The "environmental conditions" attribute shall consist of weather and atmospheric conditions (including information technology connectivity).
  - The "dynamic elements" attribute shall consist of the movable elements of the ODD, e.g. traffic, subject vehicle.

  - At the top level, "scenery elements" shall at least be classified into the following attributes or have additional attributes: a) zones; b) drivable area; c) junctions; d) special structures; e) fixed road structures; f) temporary road structures.
  -
- **§9 - Scenery elements**
-
- **§9.2 - Zones**
  - any exceptions shall be defined using the taxonomy and the format defined in this document.
  - In case a zone is defined as an ODD attribute, it shall imply that everything inside the zone is a part of the ODD unless explicitly excluded.
- **§9.3 - Drivable area**
  - It may be possible that in certain regions the above attributes are given vernacular names. In such cases, stakeholders shall define each term to enable mapping to the above attributes.
- **§10.3.2 - Wind**
  - Wind speed shall be specified in the unit of m/s. It should be characterized as an average over a specified time interval (recommended 2 to 10 min) and a gust value in m/s, which is the peak value of a 3 s rolling mean wind speed.
- **§10.3.3 - Rainfall**
  - Rainfall intensity shall be specified in the units of mm/h.
- **§11 - Dynamic elements**
  - Dynamic elements shall be further classified into the following attributes:
    - a) traffic agents;
    - b) subject vehicle.
  - The subject vehicle's maximum allowable speed shall be defined as an ODD attribute
- **§12 - ODD Definition and format**
  - An operational design domain definition (ODD) shall be valid throughout the whole vehicle's lifetime for a particular hardware and software configuration.
  - In order to make the ODD definition concise, a permissive or a restrictive definition mode or default definition mode shall be used.
  - However, they shall state which format is being used for that attribute.
  - An ODD definition in a "permissive" mode shall list only the attributes that are outside ODD definition. Rest of the attributes (unspecified) shall be considered to be part of the ODD definition.
  - An ODD definition in a "restrictive" mode means only the attributes that are inside ODD will be listed in the ODD definition. Rest of the attributes (unspecified) shall be considered to be outside the ODD definition.
  - An ODD definition in an "default" mode means the attributes of interest that are listed in the ODD definition are considered inside the ODD and will be monitored during ADS operation. Rest of the attributes (unspecified) shall be considered not to be affecting the ADS performance and may not be monitored.
  - This requires an ODD specification shall be understandable to both technical and non-technical users.
  - ODD definition format shall allow the designers to specify conditional statements or reduced ODDs.
  - Three keywords as specified in Table 1 shall be used as qualifiers to specify inclusion, exclusion and conditional nature of the attributes. Each ODD statement with a qualifier shall tackle one parent class (or higher-level ODD attribute) and shall perform the classification of its subattributes into the three categories.

Table 1 — Qualifiers for inclusion, exclusion and conditional

Qualifiers	Meaning
Include	Included in the ODD
Exclude	Excluded from the ODD
Conditional	Inclusion/exclusion of attributes have dependencies

For example, one may state: "Include" "drivable area type" is "motorway"

- **§12.6 - Objective boundaries**
  - The ODD shall be defined in a way that its boundaries are objectively specified. This shall be achieved by identifying the boundaries for the value for each ODD attribute.
  -
- **§12.7 - Statement composition**
  - For each ODD attribute statement, the following components shall be defined (Table 2):
  - — qualifier (Include, Exclude, Conditional);
  - — attribute;
  - — attribute value

Qualifier	Attribute	Attribute value
Include	drivable area type	Motorway
Exclude	drivable area type	Shared space

  -
- When the "conditional" qualifier is used, the statement composition shall have the following components:
  - · qualifier 1: Conditional
  - · qualifier 2: (Include or Exclude)
  - · attribute metric: (e.g. rainfall rate)
  - · influencing attribute: (e.g. rainfall)
  - · influenced attribute: (e.g. motorway)
  - · influencing attribute value: (e.g. light rain)
- EXAMPLE Conditional Include rainfall rate of rainfall for motorway is light rain.

ANNEXE : Canevas de description de l'ODD

Le projet SAM propose de décrire sous la forme d'un tableau Excel l'ODD du système. L'organisation avec les 6 catégories et les sous-catégories est fixe et normée.

Les attributs dans les sous-catégories sont donnés à titre illustratif. Il est de la responsabilité du concepteur du système d'en établir une liste exhaustive. L'essentiel est que cette description de l'ODD comporte tous les éléments à percevoir par le système ADS, soit :

- pour identifier et confirmer qu'il est dans son ODD (e.g : le système est opérationnel sur autoroute),
- pour indentifier que le véhicule va franchir une limite de l'ODD (e.g: le système est opérationnel et approche de la fin de l'autoroute),
- ou bien pour confirmer que le véhicule est hors de l'ODD (e.g : le véhicule n'est pas sur autoroute).

Pour chaque attribut, il faut qualifier s'il est dans l'ODD ou pas ; d'où la dernière colonne de la table de l'ODD à remplir avec :

INCLUS	Élément dans l'ODD, nécessaire à percevoir, soit pour identifier que l'on est bien à l'intérieur des limites de l'ODD, soit parce qu'il pourrait nous conduire à une situation dangereuse.
EXCLUS	Élément en dehors de l'ODD, nécessaire à percevoir, car pouvant conduire à une sortie imminente de l'ODD et donc une situation dangereuse.
/	Élément de la liste du canevas, dont il faudra biffer le texte ou supprimer la ligne, lors d'une application sur un projet donné, car elle ne sert à rien.

Nota Bene : Il est possible de décomposer la dernière catégorie « / » en deux sous-catégories :

- « / » : attribut sans effet sur la sécurité du système. Attribut qu'il n'est pas nécessaire de percevoir pour assurer la sécurité d'utilisation.
- « N/A » : attribut de la liste du canevas, mais non pertinent pour le système étudié (ex. autoroute pour un STRA avec navettes urbaines en centre-ville)

Dans la suite de cette annexe, vous trouverez une copie de la description de l'ODD retenue par les partenaires du projet SAM. Nous proposons le formalisme ci-dessous dans Word ou Excel (document joint). La référence est le document Excel, mais dans l'objectif que ce document soit autoporteur nous l'y avons inclus à la demande des partenaires.

Pour être aussi autoporteur que possible la description de l'ODD commence par une section introductive rappelant des informations très générales sur le système automatisé considéré.

Introduction

Transportation Usage - Moyen de Transport		
Public People Transpotation Transport Public de personne	*Shared use of the vhc* Véhicles à usage partagé	Yes
	Collective public transport Transport Public Collectif	Yes
	Individual public transport Transport Public Individuel	Yes
Private People Transpotation Transport Privé de personne	*Private transport services* Service de transport privé	No
	Car sharing Véhicule en auto-partage	No
	Other	No
Goods transportation Transport de Biens		No
etc…		…

Physical infrastructure - Infrastructure Physique

Roadway Types - Types de route		
Segregated lane - With strong/massive separators (guard rails, etc.) / beside a dangerous area (river, oncoming lane, pedestrian sidewalk, cyclist lane, etc.) Voie de circulation séparée - Avec des séparateurs solides/massifs (e.g. barrière de sécurité)/à côté des zones dangereuses (rivières, voie de circulation en sens inverse, trottoir pour piéton, voie cycliste, etc.)		Yes
Segregated lane - with light separators (studs, light barrier, etc.) / beside a dangerous area (river, oncoming lane, pedestrian sidewalk, cyclist lane, etc.) Voie de circulation séparée - Avec des séparateurs légers (e.g. clous ?)/à côté des zones dangereuses (rivières, voie de circulation en sens inverse, trottoir pour piéton, voie cycliste, etc.)		Yes
Not segregated lane / beside a dangerous area (river, oncoming lane, pedestrian sidewalk, cyclist lane, etc.) Voie non séparée / des zones de dangers		Yes
Single Lane Chaussée à voie unique		Yes, if other Vh Speed < 50km/h
Multiple-lanes undivided with same driving directions - without Lane Change Chaussée à voies multiples dans le même sens de circulation		Yes, if other Vh Speed < 50km/h
Multiple-lanes undivided with same driving directions - with Lane Change		Yes, if other Vh Speed < 30km/h
Multiple-lanes undivided with opposite driving directions Chaussée à voies multiples avec circulation en sens opposé		Yes, if other Vh Speed <30Km/h
Intersections with priority to AV Intersection avec priorité au véhicule autonome		Yes, if other Vh Speed <50Km/h
Intersections with give-way or stop Intersection avec céder le passage ou stop		Yes, if other Vh Speed <50Km/h
Intersections with traffic light (not connected) Intersection avec feux de circulation non connectés		No , if other Vh Speed <50Km/h
Intersections with traffic light (connected) Intersection avec feux de circulation connectés		Yes, if other Vh Speed <50Km/h
Intersections with blind corners / blind spots Intersection avec obstruction / Angles morts		Yes , if other Vh Speed <50Km/h

Roundabouts Rond-point		Yes , if other Vh Speed <50Km/h
Merging Lane : Transition from 2 lanes to 1 lane (ego vehicle on this lane) Fusion de voie(ego vehicule sur la voie qui disparaît)		Yes, if other Vh Speed <50Km/h
Merging Lane : Transition from 2 lanes to 1 lane (ego vehicle NOT on this lane) Fusion de voie (ego vehicule pas sur la voie qui disparaît)		Yes , if other Vh Speed <50Km/h
Merging in Fusion de 2 voies		Yes, if other Vh Speed <50Km/h
Branching / Exit / merging out (City) Ramification / Voie de sortie / Création de voie		Yes, if other Vh Speed <50Km/h
Passengers Stations / Notched Station (Arrêt) / Arrêt déporté en dehors de la voie	*Other vhc speed ≤ 30 km/h*	Yes, if other Vh Speed <50Km/h
Passengers Stations / In Lane Station (Arrêt) / sur la voie de circulation		Yes
*Bridges / **Gap**, ditch* Pont / Fossé		Yes
Crosswalk Passage Piéton		Yes
Tunnel, underpass Tunnel, passage souterrain		Yes
Railway crossing Passage à niveau	*Without barriers*	No
	With Signals - Not connected	No
	With Signals - Connected	Yes Cf. Connected signage
Construction area *Zone de construction*		Yes
Parking (surface lots, structures, private/public) *Zone de Parking*		Yes
Loading and Unloading Zones Zones de chargement / déchargement		Yes
etc.		/
Highway-specific Roadway Types		
Divided Highway Autoroute, Voie rapide (à chaussées séparées par une barrière physique)		No
Undivided Highway Autoroute, Voie rapide sans barrière physique entre les sens de ciculation		No
Road with regulated access Routes à accès limité		No
Tollgate Barrière de Péage		No
Border office Douane		No
Interchange Echangeur		No

Slip Road (ego vehicle on this road) Bretelles d' Entrée & Sortie (ego véhicule sur cette voie)	No
Slip Road (ego vehicle not on this road) Bretelles d' Entrée & Sortie (ego véhicule sur la voie adjacente)	No
etc.	/
Roadway Surfaces **- Surface de la route**	
Asphalt Asphalte	Yes
Concrete Béton	Yes
Mixed (Asphalt + concrete)	Yes
Grating Grille (*e.g.* grille d'égoût)	No
Cobblestones	No
Brick Pavés	No
Dirt Poussières, Saletés sur la route	No
Gravel Graviers	No
Scraped road Route grattée	No
Speed bumps Ralentisseurs	Yes
Potholes Trous / Nids de Poule	No
Grass Herbe	No
etc.	/
Roadway Edges **- Bords de route**	
Sidewalks Trottoirs	Yes
Parking areas Places de parking	Yes
Cyclist lane Voie Cycliste	Yes
Gap / Ditch alongside the lane Fossé le long de la voie	Yes
Dock, Ravin, River alongside the lane Eau le long de la voie	Yes
Shoulder (paved, gravel, grass) Accotement	/
Lane barriers, Segregation components Barrière de sécurité	*Cf. Roadway Types*
Emergency Lane Bande d'Arrêt d'Urgence	/
etc.	/

Lane markings - Signalisation horizontale	
Lane markings Signalisation horizontale	Yes = Clear markers Oui = marquages détectables
Temporary lane markings Signalisation horizontale temporaire	No
Zebras	No
etc.	/
Roadway Geometry - Géométrie de la route	
Straightaways Ligne droite	Yes
Curves Courbes	Yes if Radius ≥ XXX m
Hills - uphill - [%] Pentes ascendantes	Yes if gradient ≤ XXX
Hills - downhill - [%] Pentes descendantes	Yes if gradient ≤ YYY
Lane width - [m] Largeur de voie [m]	≥ XXX
etc.	/

Operational Constraints - Contraintes Opérationnelles		
Speed Limits - Limites de vitesses		
Minimum - [km/h]		0
Maximum - [km/h]		≤ XXX
Speed of Surrounding Traffic Relative au trafic environnant		Cf. Roadway Types
etc … etc …		/
Traffic Conditions - Conditions liées au trafic		
Average Traffic density - [/h] Densité de trafic	*≤ XXX*	/
	] XXX ; YYY]]	/
	> YYY	/
etc … etc …		/
Operational Conditions		
Max passenger capacity per vhc - [passengers]		≤ XXX (seated passengers) ≤ XXX (standing passengers) ≤ XXX (overall passengers)
Max payload per vhc - [kg]		≤ XXX
Max number of vhc per site - [vhc]		≤ XXX
etc … etc …		/
Driver and Operator Conditions - Conditions liées au conducteur ou à l'opérateur		
Present in seat Présence dans le siège		*Yes*

Attentive Attentif		*Yes*
On board Safety Operator Opérateur de sécurité à bord	*Always required onboard* Toujours à bord	No
	Always attentive Toujours attentif	No
etc … etc …		/

Objects **-** **Objets**	
Passive Vertical Signage **-** **Signalisation Verticale passive**	
Signs (e.g., stop, yield, speed limit, school zone, etc.) Panneau de signalisation	/
Tunnel traffic light Feux de signalisation en Tunnel	/
Crosswalk sign Panneau de passage Piéton	/
Railroad crossing Panneau de passage à niveau	/
Stopped buses Arrêt de Bus	/
Construction signs Panneaux temporaires de travaux	Yes
Construction cones cônes de signalisation de travaux	Yes
Temporary Closures Fermeture temporaire de voie/route	Yes
etc.	/
Dynamic Signage **-** **Signalisation variable**	
Traffic Signals (e.g. regular, flashing, school zone, fire dept. zone) Feux de signalisation	/
Dynamic speed limit	No
Dynamic Traffic Signs Panneaux à message variable	No
Variable Speed Limits Limitation de vitesses variables	No
etc.	/
Human signs **-** **Trafic dirigé par un humain**	
Human-Directed Traffic Trafic dirigé par un être humain *(agent de police, ouvriers de chantier, etc.)*	No
Human injunctions Injonction faites par un humain (ralentir, se déporter vers la gauche, etc.)	No
etc.	/
Roadway Users **-** **Usagers de la route**	
Road Vehicles Véhicules routiers	Yes for cars, light trucks, large trucks, buses, motorcycles, wide-load, emergency vehicles No for Bicycle , horse-drawn carriages/buggies, scooter, Moped

VRU / Pedestrians Piétons	Yes
VRU / Cyclists Cyclistes	Yes
Emergency Vehicles Véhicules d'urgence	No : Audio signalisation devices No : Visual signalisation devices Yes : V2V Messages Cf. Connectivity
Specific / peculiar vehicles Véhicule spéciaux / spécifiques	No
etc.	/
Non-Roadway Users & Obstacles **-** Non usagers de la route et Obstacles	
Negative obstacles (holes, missing mancover, potholes, etc.) Obstacles négatifs (Trou, nid de poule, etc.)	No
Animals (e.g., dogs, deer, etc.) Animaux	Yes if ≤ XXX mm No if > XXX mm height
Debris, lost cargos, etc. (e.g., pieces of tire, trash, ladders) Debris (e.g. pneu, déchets)	Yes if ≤ XXX mm No if > XXX mm height
Wind-blown objects (leaves, debris, dust/dirt, sand) Objets emportés par le vent (feuilles, débris, poussière, sables)	No
etc.	/

Environmental conditions **-** Conditions environnementales

Weather **-** Climat	
Wind - km/h Vent	≤ XXX km/h stabilized ≤ YYY km/h peak
Rain - mm/h Pluie	≤ XXX mm/h
Snow Neige	No
Sleet Grésil, Neige fondue	No
Operating Temperature - °C Température d'Opération	Min : Max : ≥ XXX
Storage Temperature - °C Température de stockage	[XXX , YYY]
Humidity Rate - % Taux d'humidité	≤ XXX
etc.	/
Weather-Induced Roadway Conditions	
Standing Water - mm Accumulations d'eau	≤ XXX mm
Flooded Roadways Route innondée	No
Icy Road Route verglacée	No
Snowy Road - mm Route enneigée	≤ XXX mm
Mud Boue	No

	etc.	/
	Particulate Matter - Particules	
	Adverse Visibility (Fog, smoke, smog, dust/dirt, etc.) Visibilité dégradée (Brouillard, Pollution, Fumée, poussière, etc.)	No if Visibility ≤ 100 m Yes if Visibility > 100 m
	etc.	/
	Illumination	
	Day (sun: Overhead, Back-lighting and Front-lighting)	Yes
	Dawn, Dusk Aube, Crépuscule	Yes
	Night Nuit — *With Street lights* Eclairage public	Yes
	Night Nuit — *Without Street lights* Sans éclairage public	Yes
	Headlights (Regular & High-Beam) Lumière des autres véhicules	Yes
	Oncoming vehicle lights (Overhead Lighting, Back-lighting & Front-lighting) Eclairaige des véhicules venant en sens inverse	Yes
	etc.	/
	Time of the day - Période de la journée	
	Availability Disponibilité	From - 09:00 AM To - 10:00 PM
	etc.	/
	Connectivity - Connectivité	
	Vehicles - Véhicules	
	V2I communications required Communication V2I (Unités de Bord de Route en courte portée (ITS-G5/C-V2X))	Yes for some roadway types Cf. Roadway Types
	V2V communications required Communication V2V	No
	Emergency vehicles V2V C-ITS required Véhicules prioritaires	Yes
	V2Device - V2Network Véhicules Vers Device - Réseaux	No
	etc.	/
	Remote Fleet Management System - Supervision	
	Does the system require an operations center ? Nécessité d'un Poste de Contrôle Centralisé (PCC) ?	Yes
	Remote operation Intervention à distance	No
	Remote operator required Télé-opérateur — *Always on duty*	Yes
	Remote operator required Télé-opérateur — *Always attentive*	No
	etc.	/
	Infrastructure Sensors - Capteurs de l'infrastructure	
	Work zone alerts by Connectivity Alerte de zone de Travaux	Not required
	Vulnerable road user by Connectivity Usagers vulnérables de la route	Yes, C-ITS required for crosswalks with occlusions

Routing and incident management by Connectivity Management du trafic et des incidents de la route	Not required
etc.	/
Digital Infrastructure - Infrastructure numérique	
3G / 4G	Yes, required.
GPS / GNSS GPS	Yes, required.
Reference Maps (e.g. 3D HDMAP) Carte Haute Définition	Yes, required.
Pothole Locations Positon des nids de poule	Not required
Weather Data Informations Météorologiques	Yes, required.
Connected Signals (traffic lights, railway crossing, etc.) Signalisations connectées (feux de circulation, passages à niveau, etc.)	Yes, required for some roadway types Cf. Roadway Types
etc.	/

ZONES		
Geofence area - Zones particulières		
Fixed Route Parcours prédéfinis		Yes
Private Site Area	*Ungated / Roads accessible to public traffic*	Yes
	Gated / Roads NOT accessible to public traffic	Yes
Urban Area (downtown, Central Business Districts, School campuses, etc.) Zone Urbaine : Centre-ville, Quartier d'affaires, Campus Scolaire, etc.)	*Roads accessible to public traffic*	Yes
	Roads NOT accessible to public traffic	Yes
etc.		/
Regions/States - Régions & états		
Legal/Regulatory Législation/Règlementation		UN-ECE member states
Enforcement Considerations		No
Tort *Délit - Infraction au code de la route*		No
etc.		/
Interferences zones		
Tunnels Tunnel		Yes
Area clear of infrastructures and buildings Zone sans aucune infrastructure ou immeuble		Yes
Urban canyon Canyon urbain		Yes
Multiple reflectivity Réflexion multiples		Yes
Parking Garage Zone de stationnement		/
Dense Foliage Feuillage dense		Yes

	Limited 3G / 4G Perturbations 3G / 4G	Yes
	Limited GPS / GNSS Perturbations GPS / GNSS	Yes
	etc.	/

Bibliography

[1] NHTSA, "A Framework for Automated Driving System Testable Cases and Scenarios", US DOT, NHTSA, September 2018, 180pp
https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13882-automateddrivingsystems_092618_v1a_tag.pdf

[2] EC, "GUIDELINES ON THE EXEMPTION PROCEDURE FOR THE EU APPROVAL OF AUTOMATED VEHICLES", Version 4.1. The guidelines hereafter have been supported by the Technical Committee on Motor Vehicles of 12 February 2019
https://ec.europa.eu/growth/content/guidelines-exemption-procedure-eu-approval-automated-vehicles_en

[3] PFA, "French automotive industry Safety Argumentation for automated vehicles. SAE automation levels 3 and 4" PFA/ CSTA14/ Safety Working Group, march 2019.

[4] WP29 Secretariat, "Revised Framework document on automated/autonomous vehicles", ECE/TRANS/WP.29/2019/34, WP.29-178-10-Rev.2 , 25-28 June 2019
https://www.unece.org/fileadmin/DAM/trans/doc/2020/wp29/ECE-TRANS-WP29-2019-34-Rev2e.pdf

[5] GRVA, "Uniform provisions concerning the approval of vehicles with regard to Automated Lane Keeping Systems", Informal document GRVA-06-02-Rev.4, 6th GRVA, 3 – 4 March 2020
http://www.unece.org/fileadmin/DAM/trans/doc/2020/wp29grva/GRVA-06-02r1e.pdf

[6] SafAD, "Safet First for Automated Driving", July 2019

https://www.daimler.com/innovation/case/autonomous/safety-first-for-automated-driving-2.html

[7] NHTSA, "Automated Driving Systems 2.0 – A Vision for Safety", NATIONAL HIGHWAY TRANSPORTATION SAFETY ADMINISTRATION, 2017.

https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf

[8] SAE J3016 – ISO 22736, "Intelligent Transport Systems - Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles.", Document J3016_201806. SAE International, June 2018

https://www.sae.org/standards/content/j3016_201806/

[9] ISO TS 14812, "Intelligent Transport Systems - Vocabulary", ISO TC 204/WG 1, ISO/TS 14812 (CD stage), 2019

https://www.iso.org/obp/ui/#iso:std:iso:14813:-5:ed-2:v1:en:fn:1

[10] US DOT, "Federal Automated Vehicles Policy", September 2016

https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016

[11] CAMP, "ITS - Automated Vehicle Research for Enhanced Safety", Final Report, Automated Research Consortium, with NHTSA sponsoring, March 2016

https://www.campllc.org/avr/

[12] BMW, « BMW'S SAFETY GUIDELINES FOR THE TESTING AND DEPLOYMENT OF AUTOMATED VEHICLES",

26th International Technical Conference on The Enhanced Safety of Vehicles (ESV), June 2019

https://www-esv.nhtsa.dot.gov/Proceedings/26/26ESV-000226.pdf

[13] Thatcham Research, "Defining Safe Automated Driving", Insurer Requirements for Highway Automation,

Sept 2019

https://www.thatcham.org/defining-safe-automated-driving-download-the-report/

[14] ISO 22737, "Intelligent transport systems — Low-Speed Automated Driving (LSAD) Systems for Predefined routes — Performance requirements, system requirements and performance test procedures", TC204-WG14, on going work.

[15] PFA & DGITM, "Automated driving safety validation: proposals from the French Eco-system", PFA & French administration position paper presented to VMAD, Jan 2020

https://wiki.unece.org/download/attachments/87622683/VMAD-04-07%20French%20views.pdf?api=v2

[16] Philip Koopman, « UL 4600: Standard for Safety for the Evaluation of Autonomous Products" Edge Case Research, Voting Draft, December 2019.

https://edge-case-research.com/wp-content/uploads/2019/12/191213_UL4600_VotingVersion.pdf

[17] PFA, "Domaine D'Opération - Operational (Design) Domain", PFA / CSTA14 / Groupe de Travail "Safety" & Validation, août 2020

[18] ISO 34503, "Test scenarios of automated driving systems: Specification for operational design domain", ISO TC 22 / SC33 / WG 9, August 2023

ISO 34503:2023 - Road Vehicles — Test scenarios for automated driving systems — Specification for operational design domain

[19] DGITM, « Véhicules et systèmes de transports automatisés : Premiers principes et questions pour la définition des ODD », Document de cadrage méthodologique, mai 2022.

DGITM-ODD_dezscriptors-juin_2022.pdf (ecologie.gouv.fr)