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TRANSPORT RESEARCH ARENA
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Towards functional requirements for automated ground transport vehicles operating under harsh weather conditions

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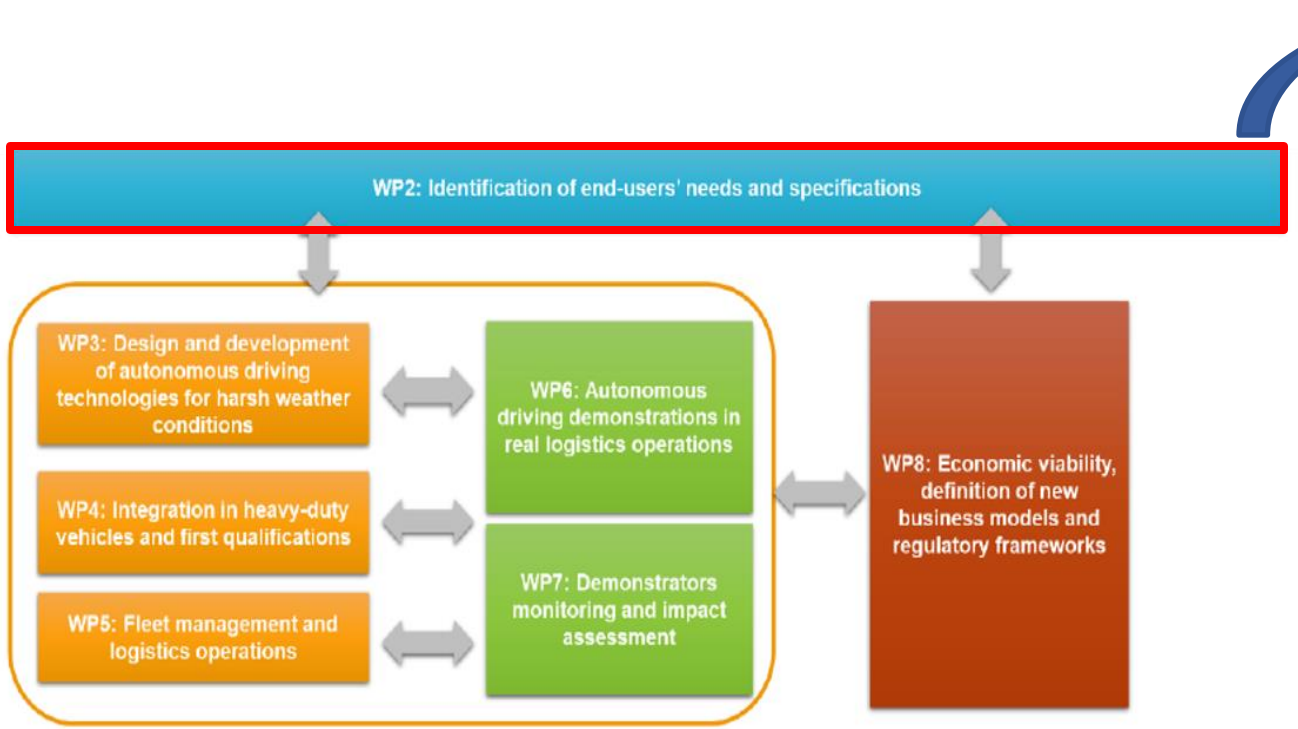
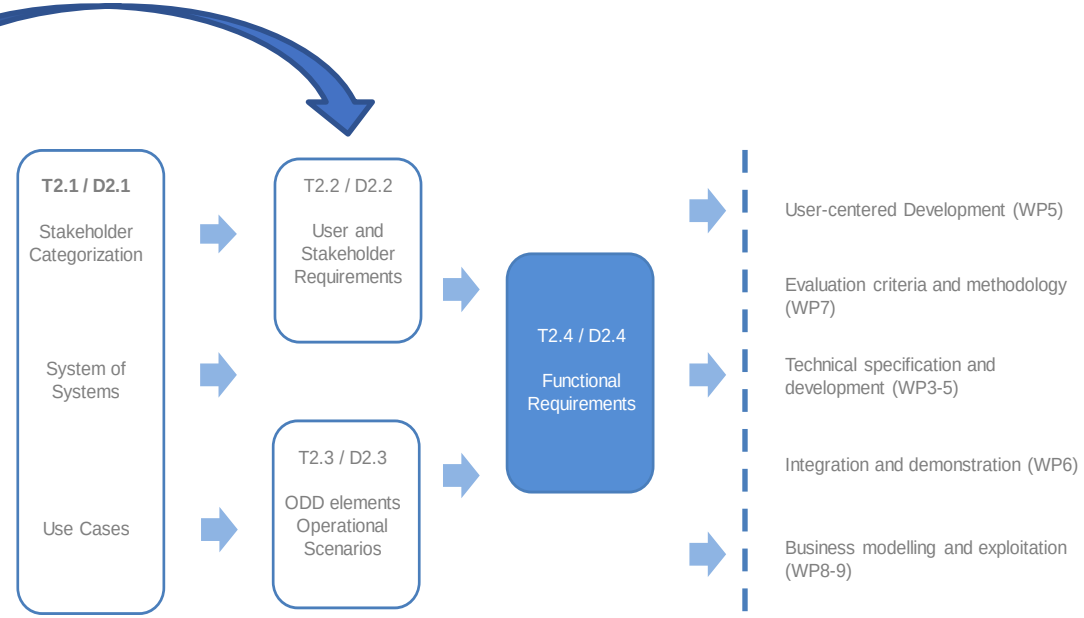
AWARD
Scaling autonomous logistics





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AWARD
Scaling autonomous logistics

- AWARD is the acronym for **All Weather Autonomous Real logistics operations and Demonstrations**
- The project has received funding from the European Union's Horizon 2020
- Consortium of 29 partners
- The main objective of AWARD is to pave the way for the roll-out of driverless transportation in a wide variety of applications and thus addressing the pain points of driver shortage and capacity utilization, whatever the weather conditions are.

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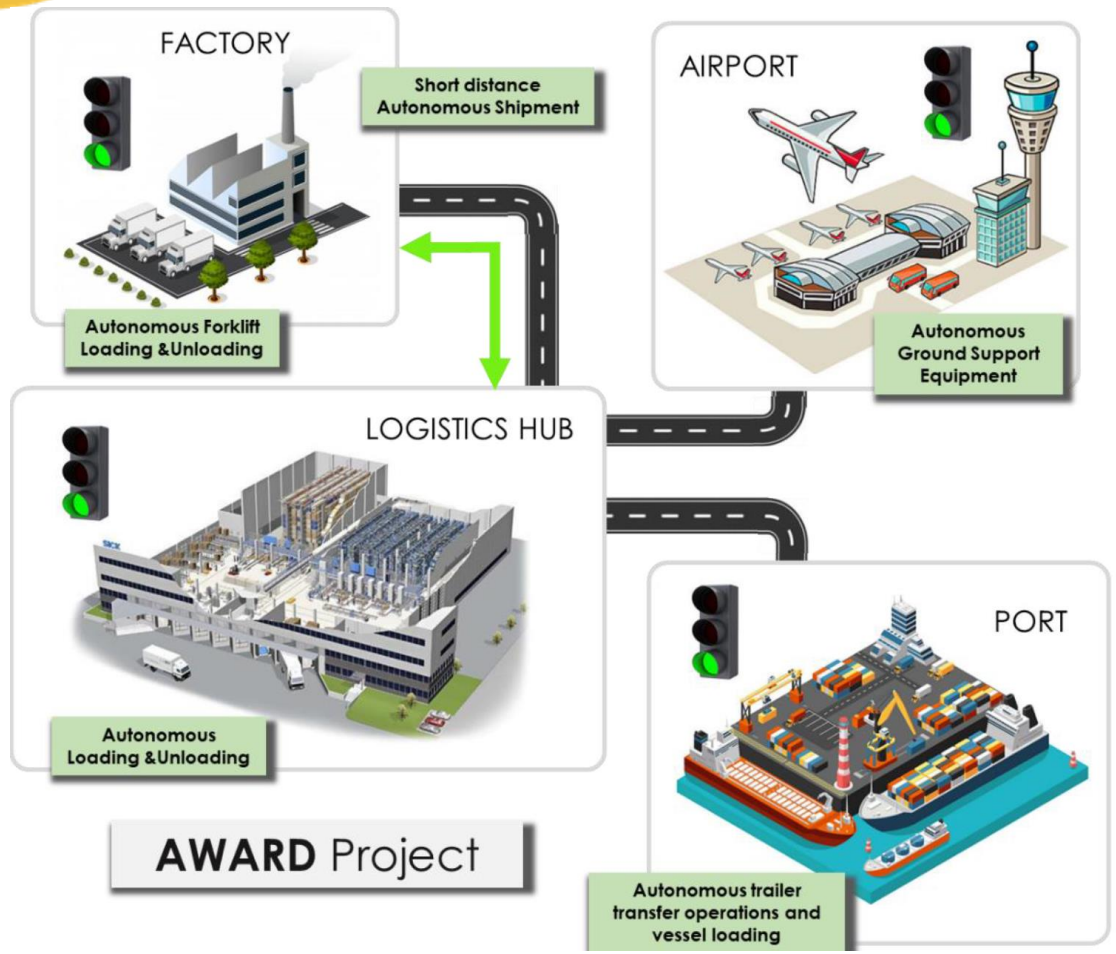

AWARD
Scaling autonomous logistics

The AWARD concept consists in developing an autonomous transport system based on driverless electric heavy-duty vehicles, capable of conducting key 24/7 logistics operations in mixed traffic, whether in confined areas or on public roads.

Four use cases:

- **Use Case 1**: Loading and transport with an automated forklift
- **Use Case 2**: Hub-to-hub shuttle service from warehouse/production site to logistics hubs
- **Use Case 3**: Automated baggage tractor on airside in Avinor OSL Gardermoen airport
- **Use Case 4**: Trailer transfer operations and automated ship loading in Rotterdam port

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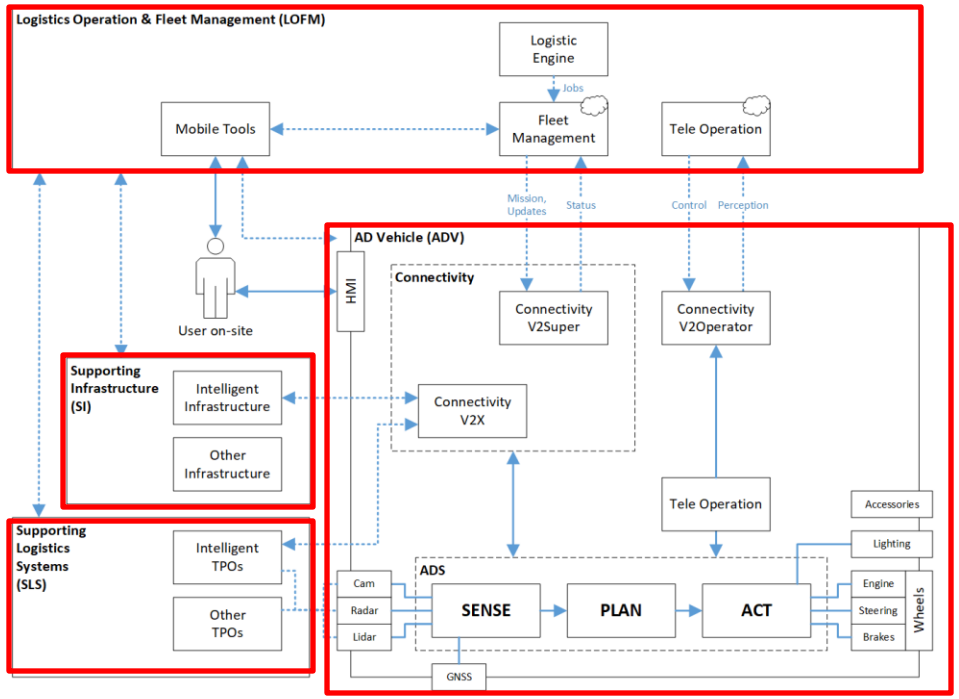
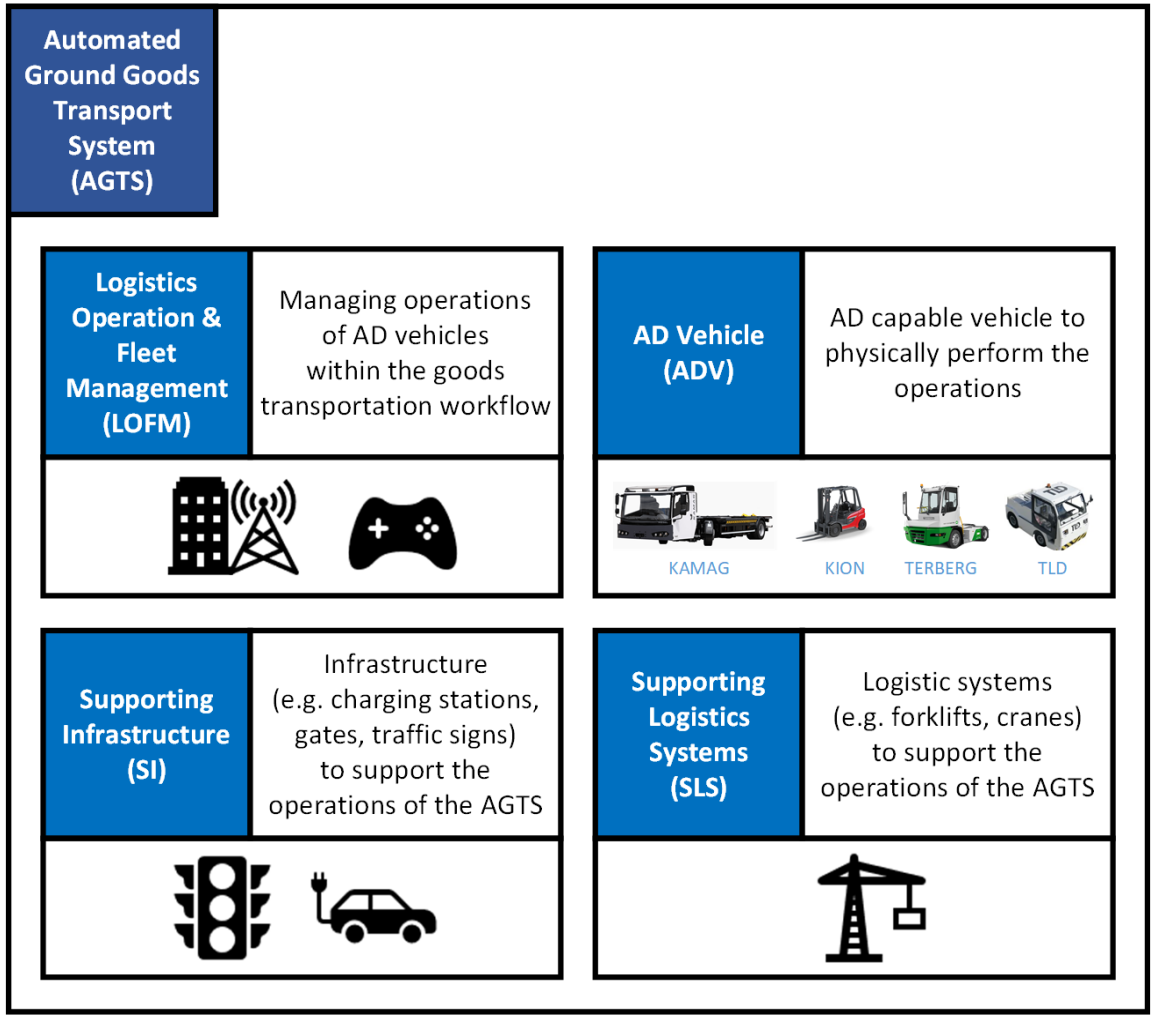
1. In the AWARD project, the concept of **System of Systems (SoS)** is used to denote a set of four interoperable systems belonging to the **Automated Ground goods Transport System (AGTS)**.





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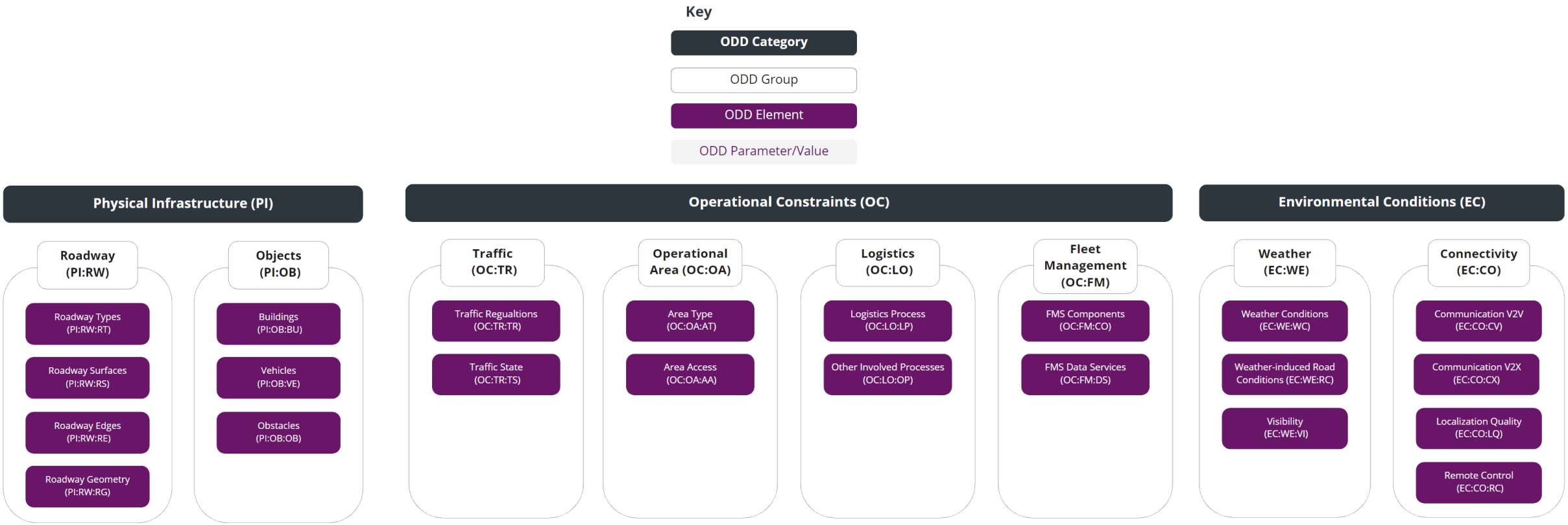
2. The **Operational Design Domain (ODD)** for the AWARD Use Cases represents the operating conditions under which an ADS is designed to operate.



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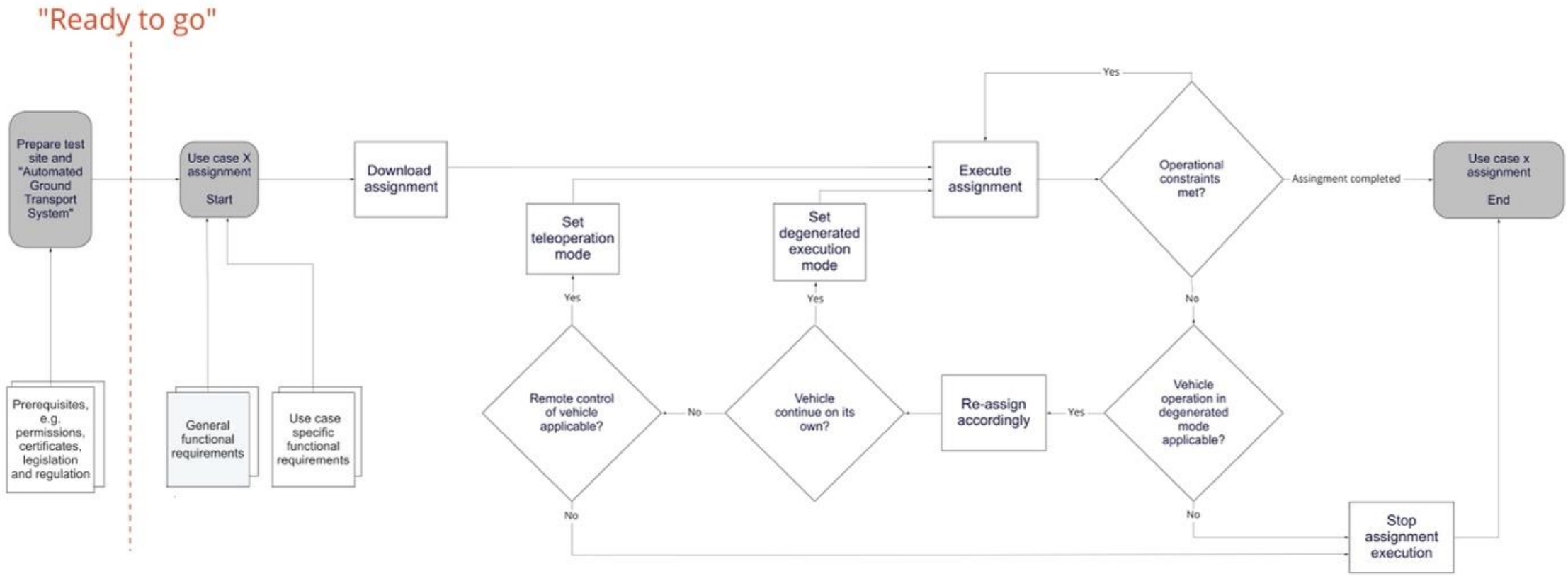
3. **Functional Requirements (FR)** detail system behaviour and serve to specify what a system (or system of systems) shall be capable of doing.



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- In this paper the methodology used to define the **Functional Requirements (FR)** needed for the AGTS setup is presented. This methodology defines FR concerning **Operational Design Domain (ODD)**- and AGTS-elements.

ODD				Requirements		
Category	Group	Element	Parameter	Relevance for system?	Why is this relevant?	Functional requirement
Environmental conditions	Weather	Weather conditions	Ice accumulation	ADV	Cannot detect edges/road markings correctly	Vehicle must be able to use alternative location detection means
Environmental conditions	Weather	Weather conditions	Ice accumulation	LOFM	Some roads cannot be used for jobs	Must keep track of vehicle position
Operational constraints	Logistics	Logistics process	Handling of goods - timeliness, positioning	SI	To support accurate positioning	Provide position data (e.g., via markers, dGPS, …)
Operational constraints	Logistics	Logistics process	Handling of goods - timeliness, positioning	SLS	To ensure timeliness	SLS prepares goods unloading/loading

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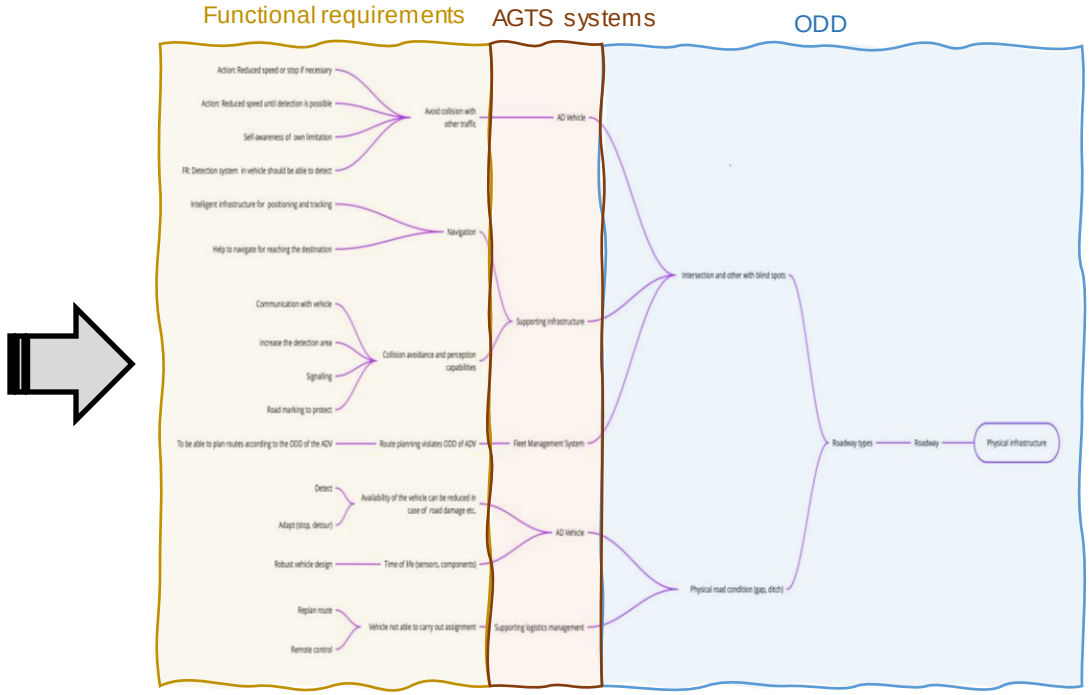

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System	Functional requirement			ODD			
	Aggregated	Context-specific explanation	Use case	Category	Group	Element	Parameter
ADV	Shall have fallback systems for positioning, detection, etc.	The ADV shall have a fallback system for positioning under ice accumulation to prevent bad detection of edges and road markings	1, 2, 3, 4	Environmental condition	Weather	Weather conditions	Ice accumulation
LOFM	Shall keep track of vehicle position	The LOFM shall keep track of the vehicle position so that it can inform the vehicle about roads that cannot be used for task completion due to ice accumulation	1, 2, 3, 4	Environmental condition	Weather	Weather conditions	Ice accumulation
SI	Shall be able to detect and report real-time position	The SI shall be able to detect and report real-time position information in order to obtain accurate execution of the assignment and support timely delivery	1, 2, 3, 4	Operational constraints	Logistics	Logistics process	Handling of goods - timeliness, positioning
SLS	Shall carry out loading/unloading process	The SLS shall prepare and carry out loading/unloading to ensure timeliness	1, 2, 3, 4	Operational constraints	Logistics	Logistics process	Handling of goods - timeliness, positioning

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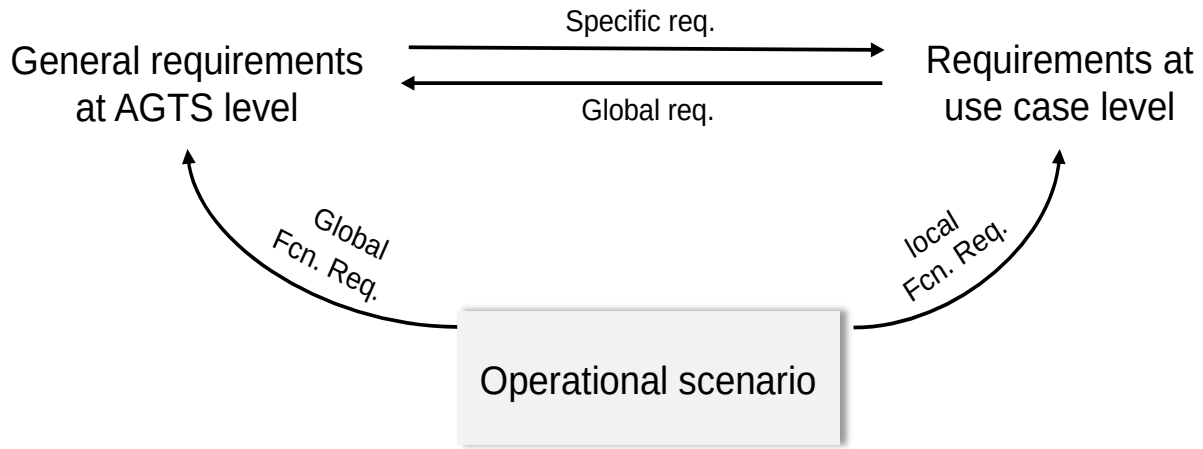
For functional requirements definition, a four-step procedure was followed:

1. Define context of functional requirements,
2. Define general functional requirements,
3. Aggregate general functional requirements,
4. Define use case specific functional requirements.



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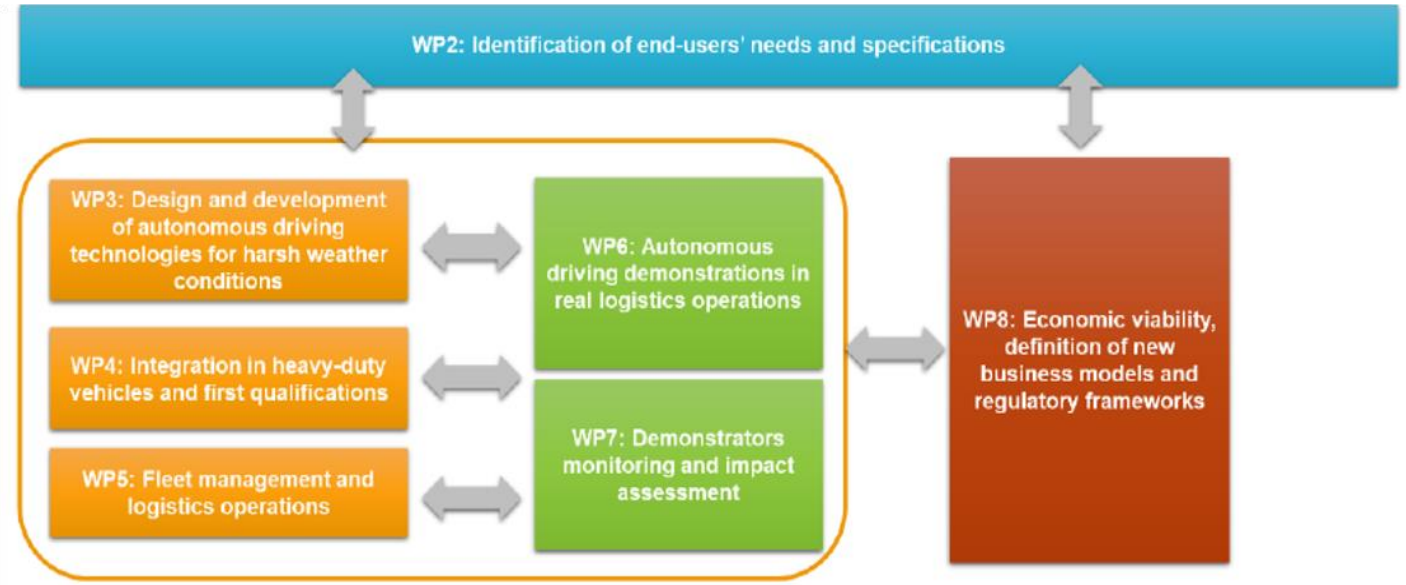
- This interlinked documentation allows to derive functional requirements for a certain subsystem within a specific use case and investigate especially the requirements related to the ODD category physical infrastructure.

- It should be noted that the functional requirements are not to be considered mandatory. These are "should-have" requirements and should be assessed by the use cases before decisions on whether and how they can comply.



Thank you!

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