How to consider innovative validation method for safety of automated vehicle

国土交通省

Ministry of Land, Infrastructure, Transport and Tourism

・Guideline regarding Safety Technology for Automated Vehicles was developed to promote the development and practical application of safe automated vehicles of the levels 3 and 4 even before internationally harmonized requirements and validation methods are developed.
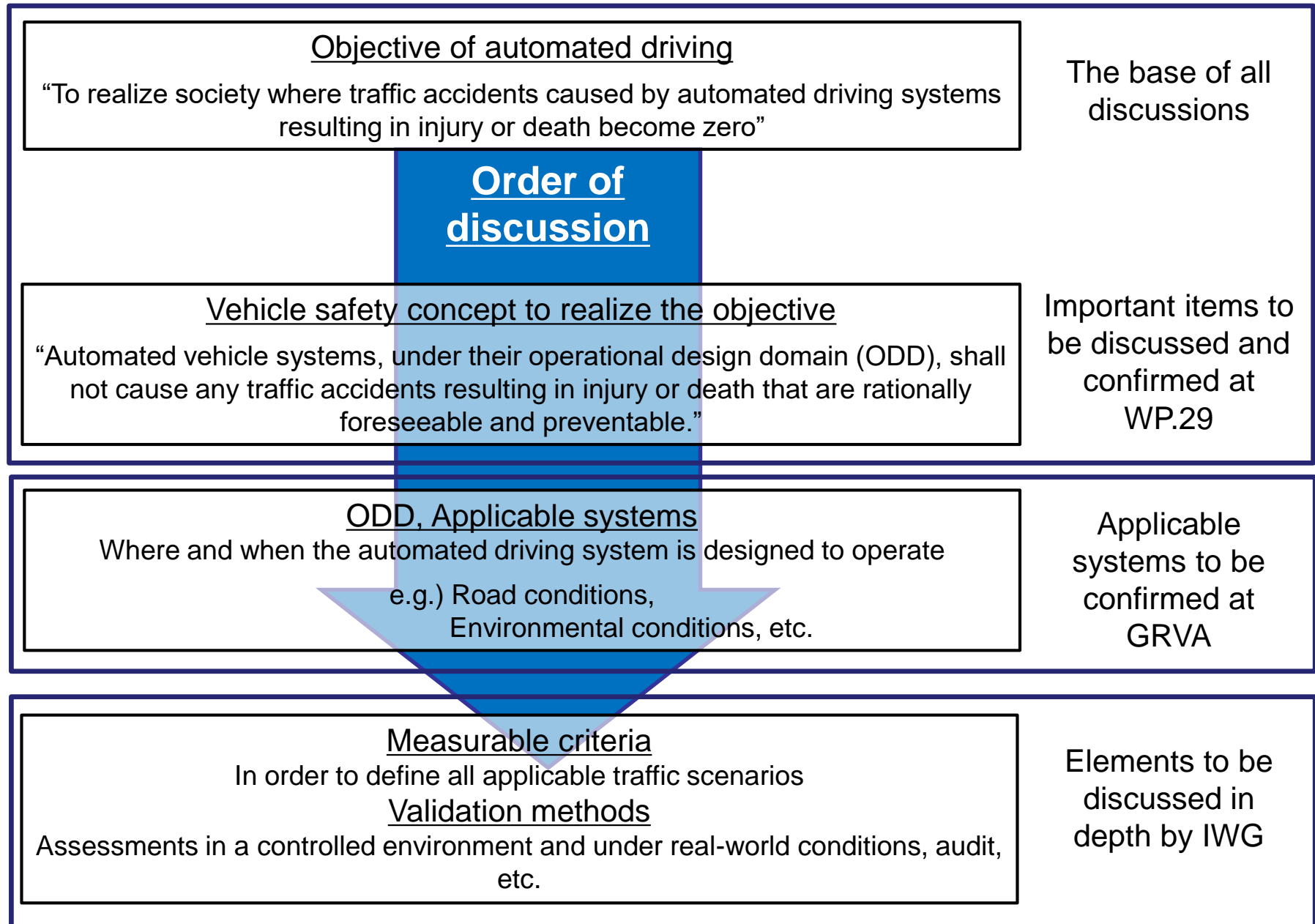
Basic stance on safety of automated vehicles

➢ The Guideline sets the objective of development and practical application of automated vehicles as such that "**realizing a society in which occurrence of accidents resulting in injury and death caused by the automated driving system is reduced to zero.**"

➢ Towards the realization of the objective, the Guideline defines vehicle safety concept to be satisfied by automated vehicles as such that "**automated driving systems, under their operational design domain (ODD), shall not cause any traffic accidents resulting in fatalities and injuries that are rationally foreseeable and preventable**" and establishes vehicle safety elements and their requirements based on the vehicle safety concept.

※ This guideline will be revised as necessary according to technological development, formulation of international regulations, and other factors in the future .

Vehicle safety elements for Automated Vehicles (10 elements)

Automated vehicles should meet the following requirements in each element to ensure their safety

Elements related to vehicle safety		Main requirements
(i)	Establishment of operational design domain (ODD)	To define the operation design domain (specific conditions of a traveling environment in design which is the prerequisite for correct operation of automated driving system: ODD) in accordance with the performance and the manner of use of individual automated driving vehicles.
(ii)	Safety of automated driving system	• To ensure system safety by securing redundancy of control systems and sensor systems • To finally stop vehicle safely when automated driving cannot be continued in the case where the vehicle is found outside of the established ODD range.
(iii)	Compliance with safety regulations, etc.	• To satisfy safety regulations of road transportation vehicles already established on automated driving. • To recommend the satisfaction of related international standards such as ISO, etc.
(iv)	Human Machine Interface (HMI)	To equip with HMI having the following functions in order to inform the driver or the occupant of the operational status of the automated driving system, etc. • To equip automated driving vehicles of level 3 with a function capable of monitoring that the driver is in condition to replace the system for driving operations and warn an alarm as necessary (driver monitoring system, etc.) • To equip automated driving vehicles of level 4 with a function capable of determining that the system is unable to continue automated driving and informing in advance the driver or the occupant (operation manager) of stopping them automatically.
(v)	Mounting of a data recording device	To equip a device to record the operational status of automated driving system and driver's status as data.
(vi)	Cyber security	To design and develop a vehicle in consideration of cyber security such as hacking in light of latest requirements of the UN (WP29) for cyber security.
(vii)	Safety of vehicles for unmanned automated driving transportation service (additional requirements)	To equip automated driving vehicles used for unmanned transportation service (level 4) with a camera which allows an operation control center to monitor the conditions inside the vehicle and a function to automatically report to the same at the time of emergency stop, in addition to the requirements of (1) to (6).
(viii)	Safety evaluation	To check safety in advance against reasonably foreseeable dangerous events in the established ODD by performing validation method appropriately combining simulation, track test and road tests.
(ix)	Ensuring safety in use process	To ensure safety of automated driving vehicles in use, take necessary steps such as updating of the software to ensure security management (inspection and maintenance) of automated driving vehicles and cyber security.
(x)	Provision of information to users of automated driving vehicles	To take measures to enable user of automated driving vehicles to get informed and gain an understanding of the method to use the system, range of ODD, functional limits, etc.

Objective of automated driving

"To realize society where traffic accidents caused by automated driving systems resulting in injury or death become zero"

The base of all discussions

Order of discussion

Vehicle safety concept to realize the objective

"Automated vehicle systems, under their operational design domain (ODD), shall not cause any traffic accidents resulting in injury or death that are rationally foreseeable and preventable."

Important items to be discussed and confirmed at WP.29

ODD, Applicable systems
Where and when the automated driving system is designed to operate

e.g.) Road conditions,
Environmental conditions, etc.

Applicable systems to be confirmed at GRVA

Measurable criteria
In order to define all applicable traffic scenarios
Validation methods
Assessments in a controlled environment and under real-world conditions, audit, etc.

Elements to be discussed in depth by IWG

- ## Examples of technical requirements/recommendations

  Vehicle safety concept to realize of the objective

  "Automated vehicle systems, under their operational design domain (ODD), shall not cause any traffic accidents resulting in fatalities and injuries that are rationally foreseeable and preventable."

  - Definition of the range of driving environment conditions
    - Definition of ODD, applicable systems, condition of transition to manual control (TD)
  - Measurable criteria
    - Definition of all applicable traffic scenarios

- ## Examples of test methods

  At this stage, these 3 are available as means of verification.

  1. **Assessing the vehicle in a controlled environment**

     - **Basic performance testing**
       - Longitudinal control (adaptive cruise control, cruise control) performance, acceleration/deceleration performance, lateral control (lane keeping, lane change) performance, cornering/turning performance
     - **Testing under the severe conditions**
       - Example of safety performance: The vehicle shall be driven without causing any accidents under severe conditions of certain number of randomly selected traffic scenarios.
       - Example of sensor performance:

  2. **Assessing the vehicle performance under real-world conditions**

     - Compliance to national traffic rules / traffic laws, etc. will also be checked

  3. **Assessing the OEM's processes, and Simulation/virtual testing**

     - Its functional specifications, and information on development process and tool will be included