

The results of Technical status survey of External lighting signal for autonomous vehicles

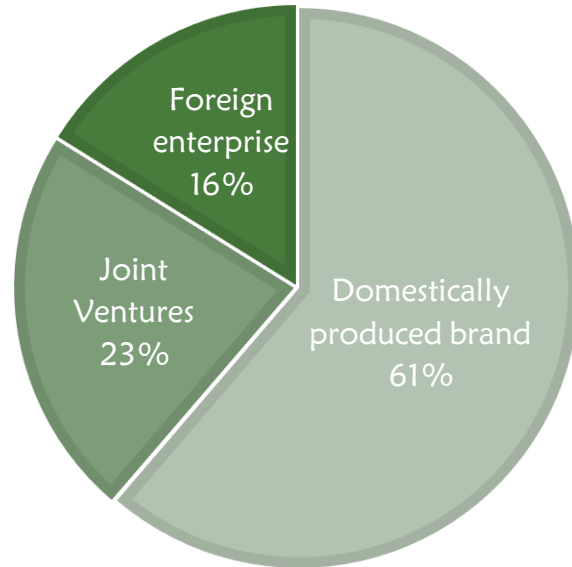
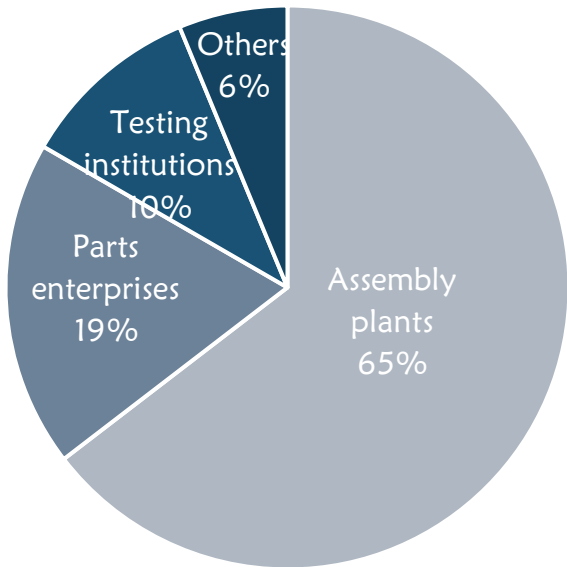
**National Technical Committee of Auto Standardization(for Intelligent and Connected Vehicle)
China Automotive Technology & Research Center Co. Ltd**

In order to understand the current situation and needs of the industry, and provide China's opinions to GRE and GRVA , National Technical Committee of Auto Standardization(for Intelligent and Connected Vehicle) (SAC/TC114/SC34) sent "Technical status survey of External lighting signal for autonomous vehicles" to key enterprises in the industry In 2020.

**全国汽车标准化技术委员会
智能网联汽车分技术委员会**

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关于开展“自动驾驶车辆专用照明设备和灯光信号装置
技术状态调研”的通知



48 feedback forms were received

Foreign enterprise, Ventures, Domestically produced brand

Assembly plants, Suppliers, Testing institutions, Others

Feedback is of mixed quality

Contents of survey

The necessity of new external lighting signal device for autonomous vehicles

The difference between autonomous vehicles and conventional vehicles in external lighting functions and device

Technical status survey

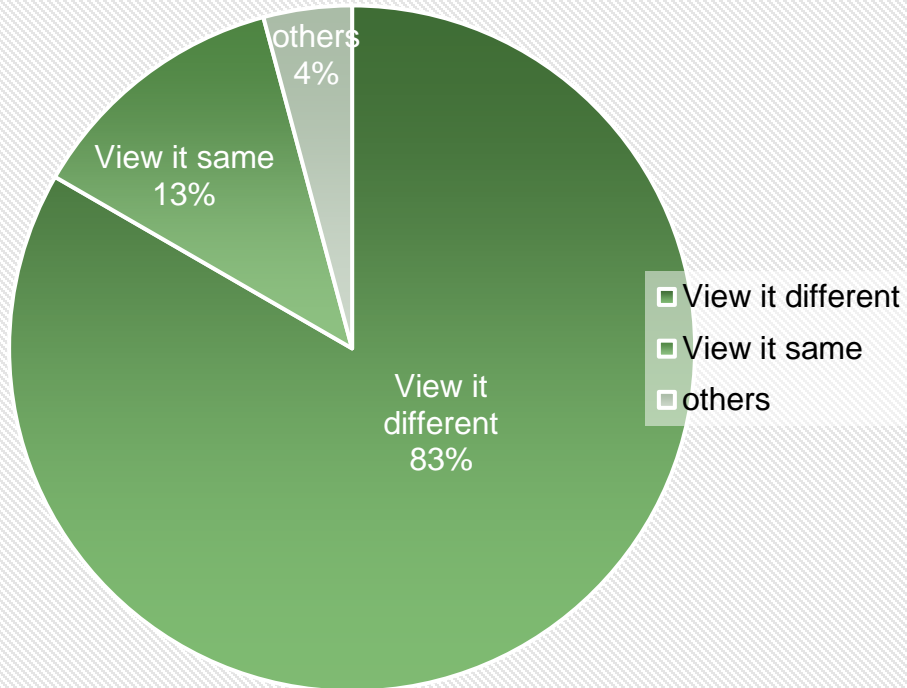
Survey of the applicability of standard and regulations

Do autonomous vehicles and future vehicles equipped with automated driving functions require dedicated lighting and external light signaling devices?

Do automated driving vehicles and traditional vehicles differ in light irradiation range, installation number, installation position, brightness requirements, irradiation position or lighting sound prompt system?

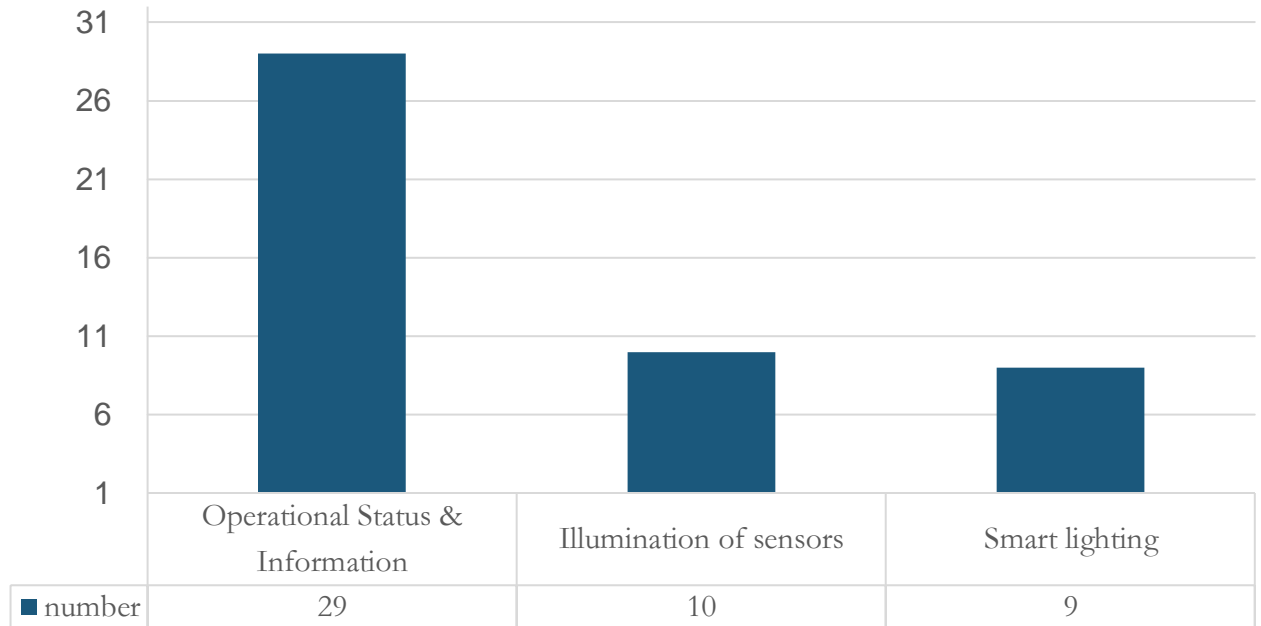
Product status and R&D plan

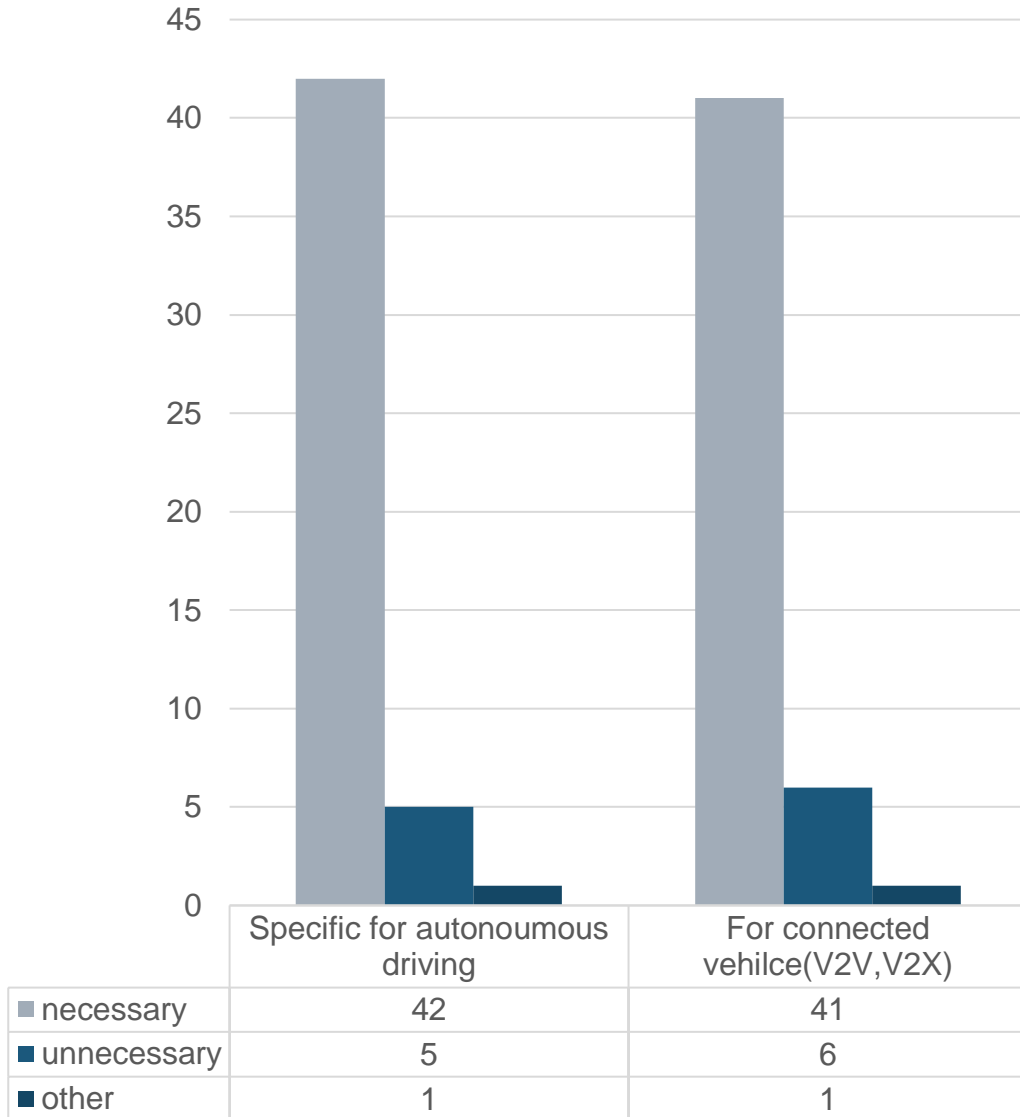
Is there an enterprise standard? Can it meet the existing standards during the research and development process?
Relevant standardization suggestions



The result addressed that, the industry still haven't reached a highly agreed consensus in the definition of ADS lighting signals and its aim. Besides the function of conventional vehicle lightings (illuminate interior and external environment), ADS light signal should also accomplish:

- 1) Operational status & Information: Through acoustic, light and wireless communication to indicate the operational status or information, which is differ from the traditional vehicle.
- 2) Illumination for sensors: Provide enough brightness for normal operation of sensors.
- 3) Smart Lighting





Reasons for ADS need dedicated lighting device:

- Provide sensors with enough brightness condition for use
- Indicate to other road users of ego operational status and intention

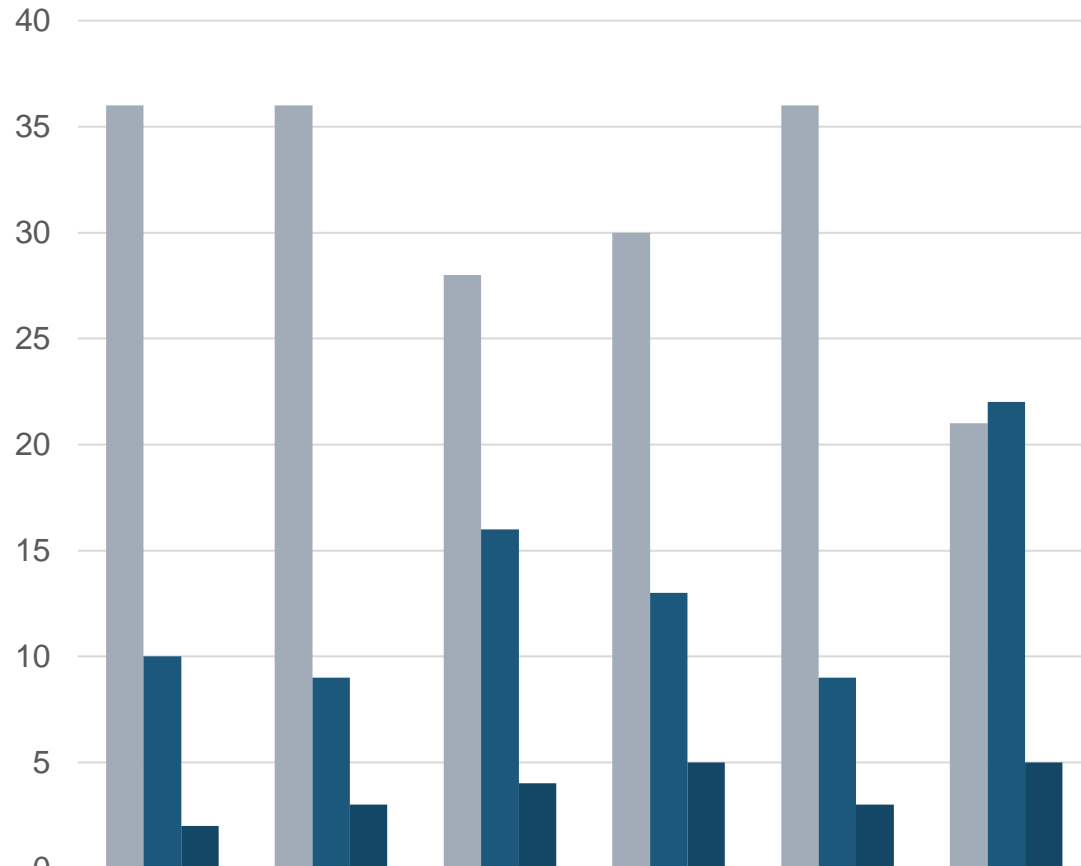
Reasons for ADS no need dedicated lighting device:

- New lighting device may cause ambiguities for other human drivers to understand.
- Too much lighting interaction with other road user may cause flash blindness even risk to crash.
- The existing lighting system meets the requirements of ADS.

The minimal function of external lighting signals for ADS :

1. Ensure that sensors can collect information at night and in bad weather
2. Remind other road users that the car is in autopilot mode and indicate the intention of driving

According to the results, the industry generally believes **that autonomous vehicles need to be equipped with dedicated lighting signal devices**



Illumination range ,brightness and other performance requirements

The user of light has gradually changed from driver to system, and the requirements of light irradiation range, irradiation position, quantity and position as well as brightness are different from those of human.

Interior lighting

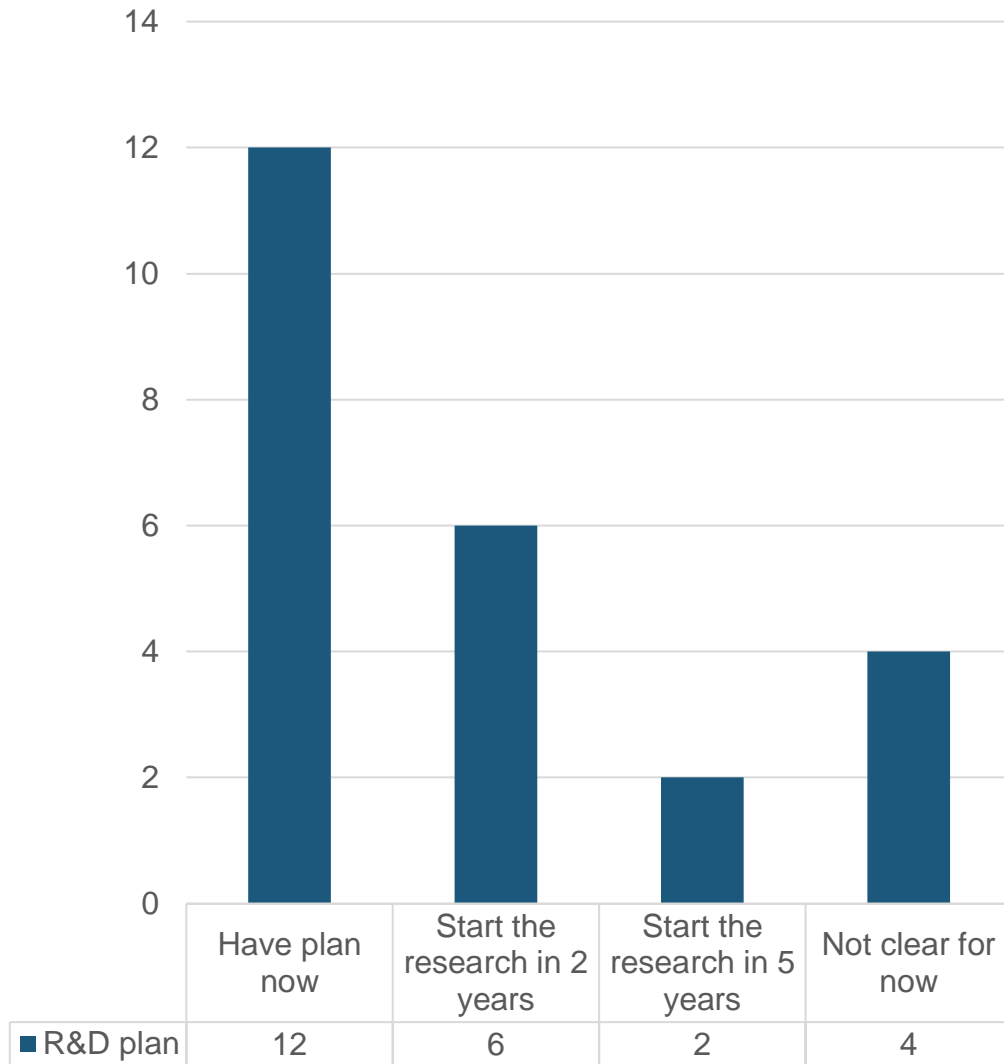
With the development of automation, ADS is responsible for more tasks than before, such as offering a bright condition for reading, creating a soft and comfort condition to drive, transferring more info to fallback driver, hazard warning, which all need interior lighting.

Sending Information

1. Operational conditions of ADS
2. Control strategy (Car following, left turning, right turning, turn round, standstill)
3. Fallback user status

Voice Prompt

- have stronger voice/semantic communication skills
- too many sound prompt will cause noise

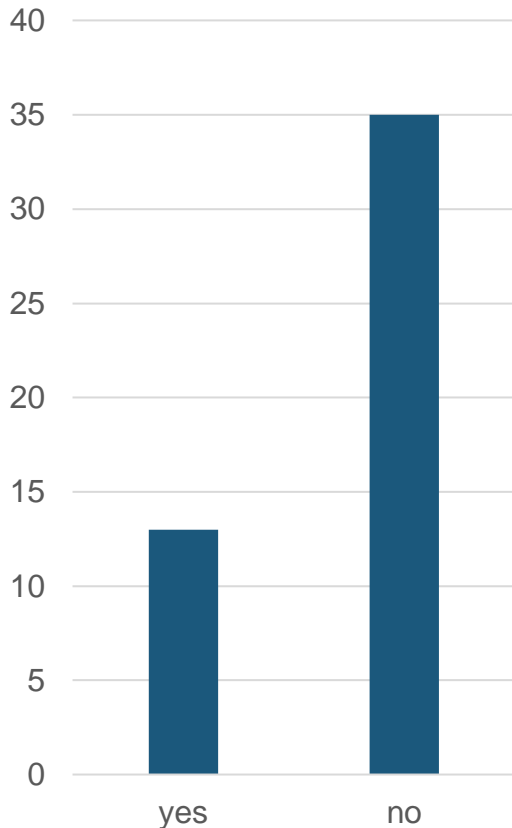


Results shows:

- There are 12 enterprises have R&D plan of lighting signals for ADS.
- Other 12 enterprises didn't start the research of relevant products, accounting for 50% of the enterprises in the survey.
- There is a need for standardization of relevant product in the industry.

At present, there are four enterprise standards for lighting equipment and light signal devices for autonomous driving

Whether any non-compliance with existing regulation has been found(China)



GB 4599 Motor Vehicles Headlamps Equipped with Filament Lamps

5.7.3 The photometric performance shall be checked on a measuring screen set at a distance of 25 m in front of the reference center.

—Most ADS was equipped with high performance camera, which could detect more than 50m in front of vehicle, while the current test benchmark is up to 25 meters.

GB 4785 Provisions for installation of the external lighting and light signaling devices for motor vehicles and their trailers

4.10 No red light shall be visible from the front and no white light shall be visible from the rear (except the lighting devices fitted for the interior lighting of the vehicle).

—The side camera need strong light in front, the irradiation Angle of the headlight need at least to be 150 degrees, which violate this term. If the light intensity can not be met, the camera cannot work well.

5.1.7.3-It shall always be possible to switch the main beam headlamps ON or OFF manually and to manually switch OFF the automatic control function of the main beam headlamps.

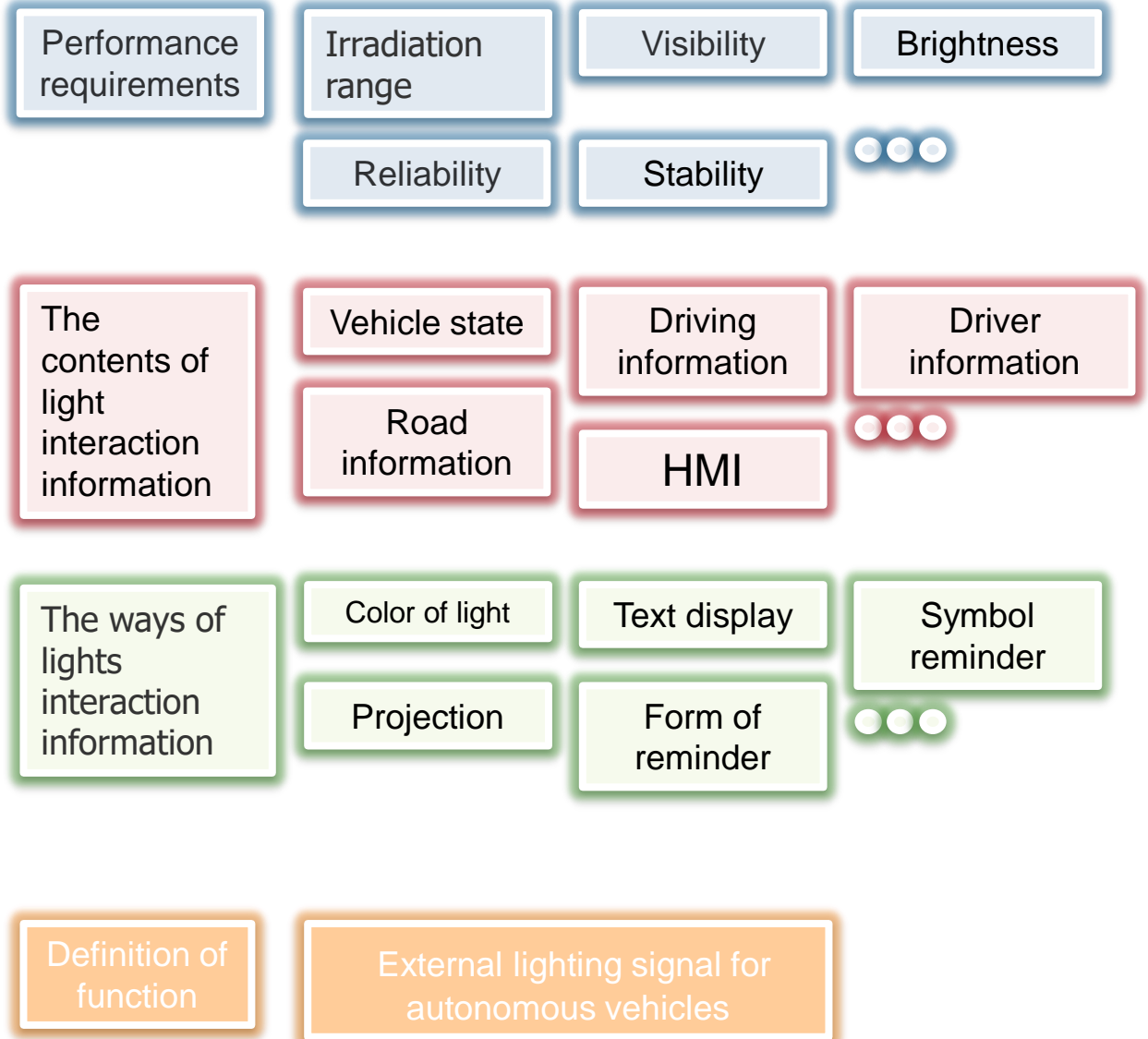
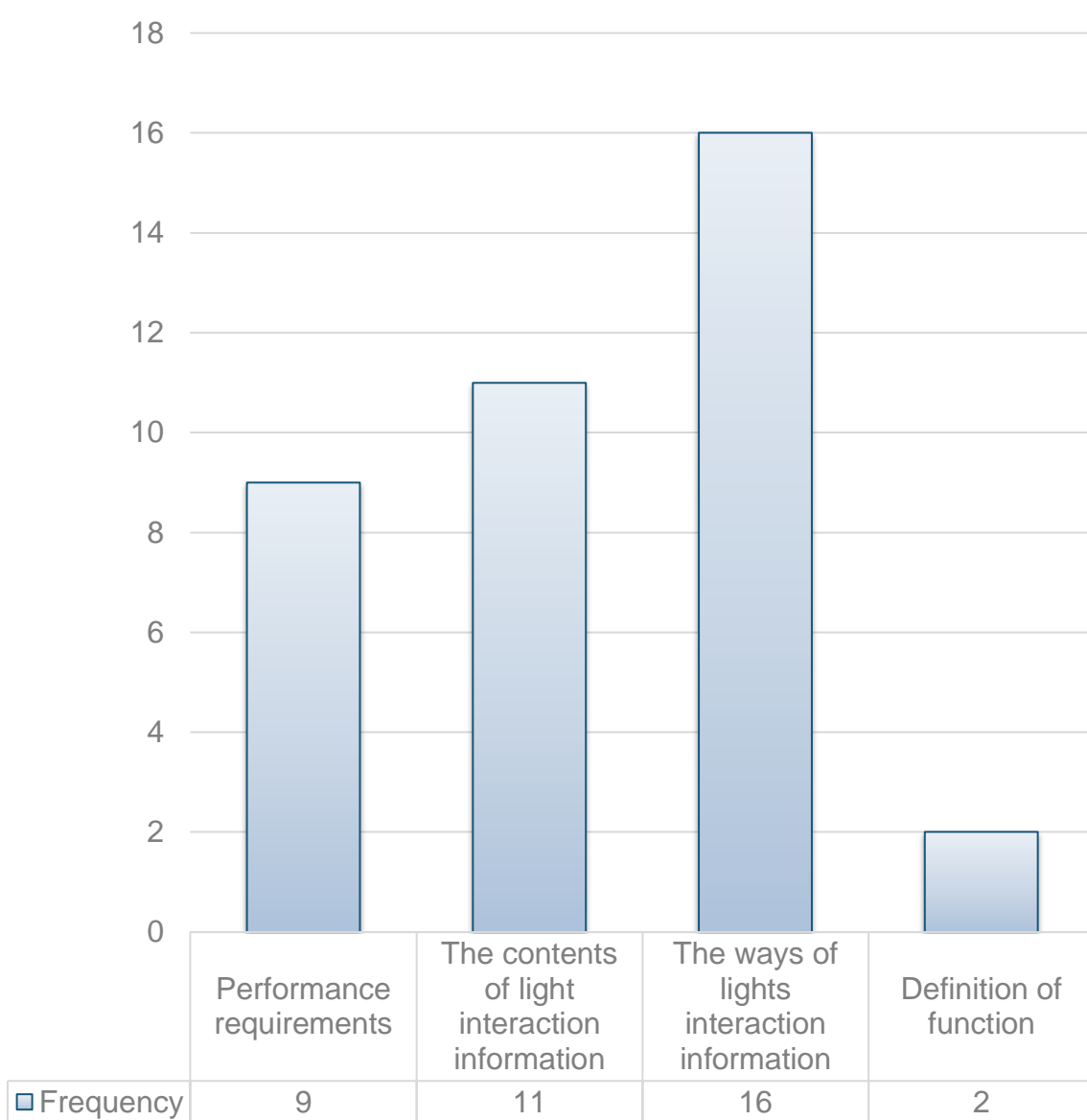
—If the main beam headlamps has been switched off, the camera cannot work well(night).

GB 7258-2017 Safety specifications for safety of power-driven vehicles operating on roads

8.1.2 No external lamp is allowed to flash, except direction indicator lamps, hazard warning signal, emergency braking signal, school bus symbol lamp, indicator lamps of special motor vehicles such as road sweeper, fence cleaning vehicle, cleaning/sweeping vehicle and dust collection vehicle under operating conditions, as well as the symbol lamps used by fire engine, ambulance, engineering rescue vehicle and police car'

—This term could limit the design of flashing lamp for AD signal.

8.1.3 Users are not allowed to refit external lighting and signaling devices, or add external lighting and signaling device which do not meet the mandatory standards, such as lamps of goods vehicle and trailer that illuminate backwards during forward running.



For quite a long time to come, Road vehicles are the coexistence of traditional vehicles driven by human beings and autonomous vehicles. Does lighting equipment of traditional vehicles and autonomous vehicles should adopt the same standard?

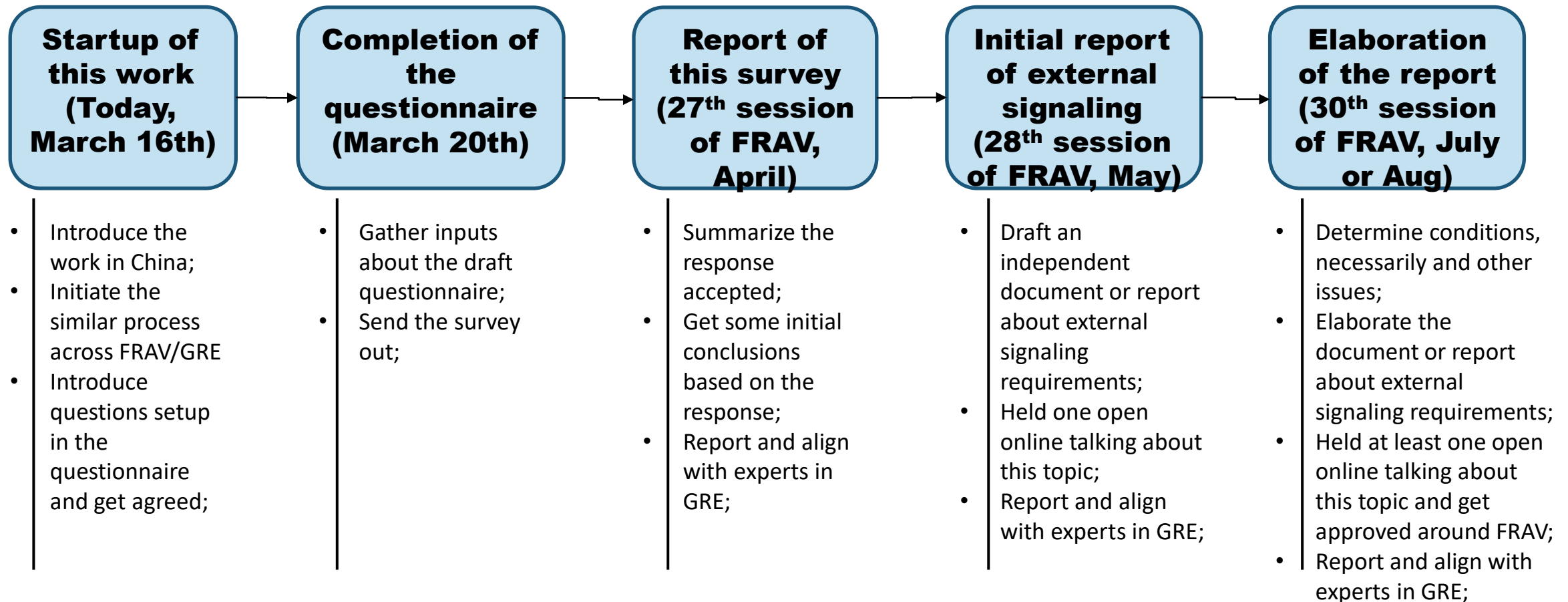
The special lighting equipment and light signal devices for autonomous vehicles shall also fully consider the passenger riding experience, road safety issues, future interaction with roadside v2x equipment.

Does a self driving vehicle need to match a lighting system independent of traditional lighting equipment?

How to consider the influence of vehicle light on the perception of other vehicle cameras

How to consider the impact of vehicle lighting on connected sensors and pedestrians.

Timeline of external signaling issues(tentative):



Thank you!

