September 2020

First approval requirements for SAE L3 systems

A guide to WP.29 Automated Lane Keeping System (ALKS)

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Management & technology consultants to the automotive industry for over 20 years

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- Autonomous
- Shared Mobility
- EV
- Cybersecurity
- Anti-theft

Our role:

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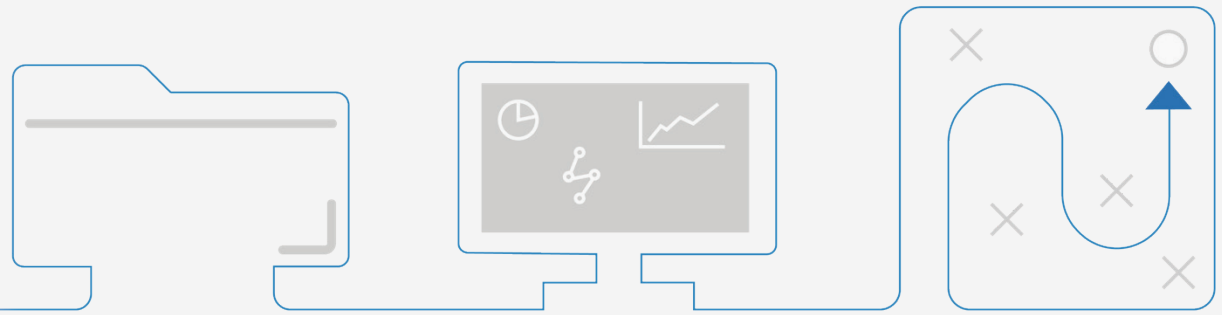

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Opening the door for SAE Level 3

This new UN regulation opens the way to SAE L3 systems of automation, where the driver can (under limited conditions) hand-over the driving task to the machine and engage in secondary tasks, **but** must be ready to regain control when notified. As with any homologation, this only provides a minimum set of conditions.

A number of limitations are worth highlighting:

- Only allowed on roads where pedestrians and cyclists are prohibited and which, by design, are equipped with a physical separation that divides the traffic moving in opposite directions.
- Operational speed is limited to 60 km/h maximum.

Consumer acceptance (and possible abuse) is going to be key to monitor, both for guiding the legislator in terms of next steps, and for the possibility of opening-up the operational conditions.

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The big picture view of WP.29 ALKS

Requirements

- **Specific documentation** is required from OEMs at the time of approval to show compliance, and any confidential data be made available on request during assessment/ audit process
- **Clear business processes** within the organization to manage the safety compliance throughout the vehicle lifecycle
- **Independent internal audit processes** are required periodically to ensure safety management processes are being complied with
- **Long-term documentation storage requirements** as potential evidence for regulators & auditors

Timing

June 2020 - The final version of WP.29 ALKS was submitted to the UN

Early 2021 – The UN is expected to give its final seal of approval

Mid 2021 – Countries like Japan and Germany who have already amended road traffic laws are likely to review laws to see if any further amendments are needed

Mid to late 2021 – OEMs could potentially introduce ALKS in the market complying with regulations

Coverage

Mid 2021 Japan and Germany are the likely first markets to allow the introduction of SAE L3 on public road per WP.29 ALKS

South Korea, United States, European Union, and UK were all active members in the development of the proposal and are likely to adopt similar regulations

Consequences

For OEMs who do not have compliant process management and systems, **introducing vehicles with ALKS will not be possible**.

For non-compliant safety or functional updates of the system, OEMs could face **revocation of type approval** for vehicles not in compliance with the guidelines.

If an OEM applies a software update which requires a modified type approval without following the correct process, in Europe, the commission may be able to revoke type approval.

History of ADAS introduction

Euro NCAP Established

1996

The first **Euro NCAP** meeting takes place, with the crash testing body's first results released the following year.

Lane Departure

2005

Lane Departure Warning
An infra-red based system to warn drivers when their car is moving out of a lane enters market

Blind Spot

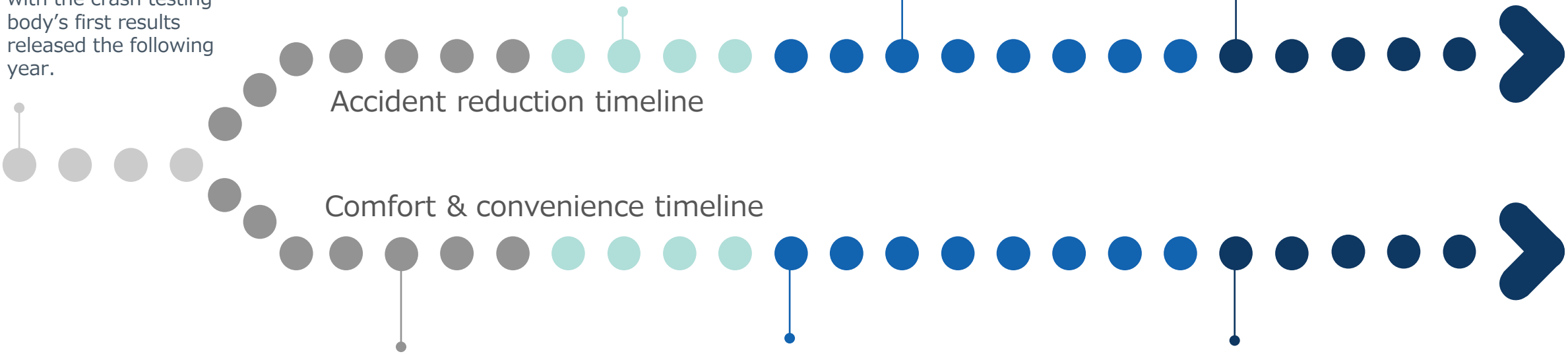
2007

Blind Spot Monitor
Visual alert to notify drivers of vehicles in their blind spots is introduced.

Collision avoidance

2008

Autonomous Braking
First-generation of low-speed auto brake solution is introduced.



Adaptive Cruise Control

1998

The first Adaptive cruise control system (controlling brakes and throttle) is introduced.

ACC with Lane support

2013

First vehicles to complement Adaptive cruise control with Lane keeping assistance are introduced

UN WP.29

2020

Type approval guidelines for vehicles fitted with Automated Lane Keeping System (ALKS) introduced.

What is WP.29 and how does it relate to ISO?

In June 2020, the UN adopted three new regulations aimed at supporting the development of connected and automated vehicles. For the first time, OEMs will need to meet binding requirements on cyber security, software updates and ALKS, a SAE Level 3 automated driving system. This guide will focus on the UN's ALKS regulation and its impact on OEMs and suppliers.

UNECE

WP.29 is the UN Working Party responsible for developing new automotive regulations

UN WP.29
SAE L3 Automated Vehicle (ALKS)

Note. The driver remains the back-up to L3 systems

UN WP.29
Cyber Security

ISO/SAE 21434 provides one option for meeting WP.29 Cyber Security.

UN WP.29
Software Updates

Includes OTA & 'wired' updates.

ISO

SAE INTERNATIONAL

ISO 26262
Functional Safety - Road Vehicles

ISO/PAS 21448
Safety of the Intended Functionality of road vehicles

ISO/SAE 21434
Cyber Security

ISO/AWI 24089
Road vehicles software update engineering

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The ALKS regulation is a step in a positive direction for the industry.

However, OEMs are faced with the challenging requirement of being able to provide evidence of compliance with traffic rules in those countries where the system is intended for launch.

The absence of clearly defined pass/fail criteria leaves some room for subjective assessment by the type approval authority.

What's involved with WP.29 Automated Lane Keeping Systems?

1

WP.29 Automated Lane Keeping Systems (ALKS) lays down requirements including – minimum road conditions where system can be activated, ensuring system safety and its failsafe operation, on handing over the driving task from ALKS to the driver and HMI to prevent driver misuse. This regulation provides two key principles that OEMs must comply with: a large set of documentation required from the OEMs demonstrating that the ALKS meets the performance requirements specified in this UN Regulation and controlled and real-world test specifications that will be assessed to verify the system's technical capability. Additionally if the system permits software updates, then the OEM also needs to demonstrate compliance with the WP.29 Cyber Security and Software Update regulations.

Documentation Requirement for Type Approval

OEMs will need to provide detailed documents covering the vehicle design, development, production and post-production phases. The documentation needs to be available in three aspects:

Application for type approval	Formal documentation	Confidential material
A set of documents that needs to be submitted at the time of type approval application. This should include: • Explanation of system design and Operational Design Domain (ODD) • Control strategies of the system • Sensing and mapping components of the system • System schematic layout • Specification on means to check correct operational status • Specification of avoiding misapplication of the system (unintended driver action) • Safe operation statement from the OEM • Demonstrate the system was designed and developed to operate in a safe manner i.e. free from unreasonable risk to the driver, passenger and other road users within the declared system boundary and compliance with traffic rules	This documentation is required to be submitted to the type approval authority who will then assess the product and the audit process. This documentation must be made available for at least 10 years from when the production of the vehicle is officially discontinued. The product assessment documentation is very similar to the list indicated under the application for type approval. The audit process documentation requirement includes: • Documentation showing effective processes and tools are in place and being complied with in the organization to manage system safety throughout the vehicle lifecycle • OEM has a communication channel in place within the various related departments (functional safety, cyber security team etc.) within the organization • Demonstrate process to monitor safety or collision issues with ALKS and manage updates to the vehicle • Report critical accidents involving ALKS to the type approval authority • OEM needs to ensure supplier safety management process complies with the ALKS regulation • Demonstrate independent internal audit process are in place to ensure safety management processes are being complied with	Any data or information which is regarded as an IP is not expected to be submitted to the type approval authority. However, the OEM will need to make this confidential data available for inspection (at the OEM site) during the product assessment and audit process. This documentation must be made available for at least 10 years from when the production of the vehicle is officially discontinued.

What's involved with WP.29 Automated Lane Keeping Systems?

2

WP.29 Automated Lane Keeping Systems (ALKS) lays down requirements including – minimum road conditions where system can be activated, ensuring system safety and its failsafe operation, on handing over the driving task from ALKS to the driver and HMI to prevent driver misuse. This regulation provides two key principles that OEMs must comply with: a large set of documentation required from the OEMs demonstrating that the ALKS meets the performance requirements specified in this UN Regulation and controlled and real-world test specifications that will be assessed to verify the system's technical capability. Additionally if the system permits software updates, then the OEM also needs to demonstrate compliance with the WP.29 Cyber Security and Software Update regulations.

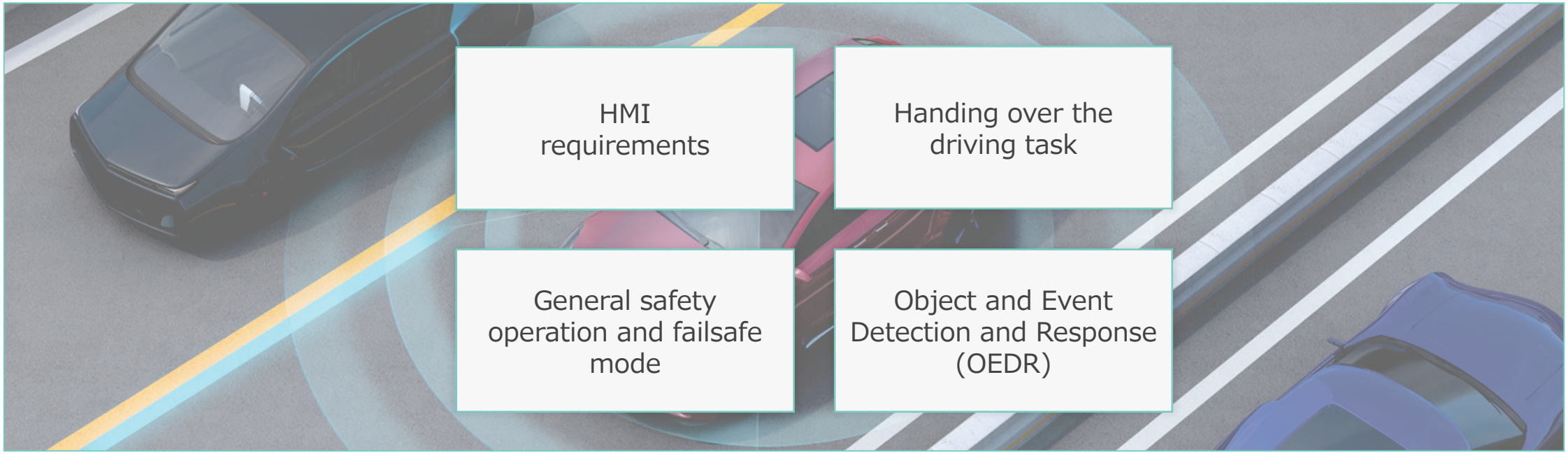
Test specifications

The test specifications provides the minimum set of tests that the technical authorities will conduct to verify the system performance as intended. The authorities could perform any other additional test within the system boundaries as defined by the OEM in the documentation provided.

Controlled test	Real-world test
All tests carried out by the technical authority will be recoded in a report ensuring repeatability. Some of the test scenarios include: • Variation of test parameter – Aspects such as ALKS speed, lane curvature etc., the variations and combinations will be defined by the technical service based on the OEM defining system ODD and its boundaries. This will be done for scenarios where collision is avoided and where collision is not expected to be avoided. • Testing of ALKS will be conducted for a minimum duration of 5 minutes. • Testing will be done for minimum of two target types – passenger car ahead and powered two-wheeler ahead. There may also be test against additional target types based on system ODD. • For up to the maximum specified speed of the system, ALKS should avoid collision against – stationary vehicle, road user and either partially or fully blocked lane. • When following a vehicle – ALKS should maintain, restore safe distance and avoid collision with a lead vehicle which decelerates up to its maximum deceleration. • Additional test cases such as entering/exiting highway, emergency vehicle etc. will be conducted if the technical authority deems this as justified conducting.	The technical authority will either conduct or witness an assessment of the ALKS in a real-world environment. Based on the submitted documentation to the type approval authority, the technical service will identity areas of system performance that may require real-world testing. The technical service will also determine the location, test route, test time and environmental conditions. The real-world assessments include: • Ensuring system cannot be activated outside of its ODD. • Complies with traffic rules and demonstrates no violation. • Response to certain planned and unplanned events. • Verifying detection of road users within the front and lateral field of view. • Vehicle behaviour in response to other road users (following distance, cut-in scenario, cut-out scenario etc). • Vehicle response during system override.

WP.29 ALKS in more detail

The regulation provides pass/fail guideline requirements on the following:



Additionally, it provides requirements relating to other aspects, such as data storage systems and cyber security, together with software updates.

The regulation is a good first step in providing some requirements that needs to be met, however, there are few areas, where the pass/fail depends on the view of the type approval/ technical service authority which could be open to an individual's interpretation, especially if such testing needs to be conducted in various countries where the ALKS is declared to operate safely.

The following pages highlight where it could be challenging from an OEM perspective.

WP.29 ALKS in more detail

	Regulation	SBD insight
System Safety and Fail-safe Response – General requirements	The activated system shall comply with traffic rules relating to the Dynamic Driving Task (DDT) in the country of operation.	• The requirement to comply with traffic rules makes it a complex challenge for OEMs. The member states in the EU have different road rules, meaning that OEMs will likely introduce by gradually expanding in various countries as opposed to availability everywhere at the same time. • Ensuring periodic update of traffic law change will be required and therefore need for OTA update provision. What is not fully clear yet is that, if more countries are added via OTA, then would the type approval process be carried out in its entirety or be confined only to the controlled and real-world test aspects?
	The activated system shall adapt the vehicle speed to infrastructural and environmental conditions (e.g. narrow curve radii, inclement weather).	• HD maps are a safety critical component with regards to fulfilling this requirement. • Variable speed limit, road work signs, lane closure will need to clearly detected, understood and managed by the system. In situations when the cellular network connection is unreliable, the operation of ALKS - especially with regards to keeping to the correct speed limit (esp. variable signs) - could pose a significant challenge.
	The activated system shall detect the risk of collision in particular with another road user ahead or beside the vehicle, due to a decelerating lead vehicle, a cutting in vehicle or a suddenly appearing obstacle and shall **automatically perform appropriate manoeuvres to minimize risks** to safety of the vehicle occupants and other road users.	• If the appropriate manoeuvre is to swerve around, the question remains whether this is acceptable, as the system needs to also comply to the definition – **"the activated system shall keep the vehicle inside its lane of travel and ensure that the vehicle does not cross any lane marking (outer edge of the front tyre to outer edge of the lane marking)".** This requirement gives a view that an evasive maneuver can take place, but only within the lane, therefore limiting its capability in terms of collision avoidance. Also, some road traffic laws require a vehicle to move to the hard shoulder in order to come to a stop in case of an emergency, creating homologation challenges for those countries.
	As part of the minimum following distance requirement, at 60km/h - Minimum time gap = 1.6 sec. Minimum following distance = 26.7 m.	• The expected following distance at maximum system allowed speed makes sense from a safety point of view. However, from a practical driving expectation, the gap ahead is probably too much (almost the length of 5 cars) allowing for a lot more cut-in scenarios. From an end-consumer perspective, this could leave the system to be quite defensive and feel an unnatural way of driving.

WP.29 ALKS in more detail

	Regulation	SBD insight
System Safety and Fail-safe Response – Driving task handover	The initiation of the transition demand shall be such that sufficient time is provided for a safe transition to manual driving.	• The term 'sufficient time' is open to interpretation and is likely to be different for different situations. • There is also the other aspect of systems being able to accommodate for different reaction capabilities of driver demographics. Ensuring a fair comparison between various systems is important and having an aspect such as "sufficient time", which could be open to various views does raise a concern on how can a fair comparison and assessment be ensured between OEMs and what they offer.
Human Machine Interface/operator information – Driver availability recognition	The system shall detect if the driver is available and in an appropriate driving position to respond to a transition demand by monitoring the driver. **The manufacturer shall demonstrate to the satisfaction of the technical service** the vehicle's capability to detect that the driver is available to take over the driving task. The driver shall be deemed to be unavailable unless at least two availability criteria (e.g. input to driver-exclusive vehicle control, eye blinking, eye closure, conscious head or body movement) have individually determined that the driver is available in the last 30 seconds.	• The driver availability seems to have a more stringent criteria compared to the attentiveness system required. • The attentiveness check is mainly being used for unintentional system override by the driver.
Human Machine Interface/operator information – Driver attentiveness	The driver is deemed to be attentive when at least one of the following is met: Driver gaze direction is confirmed as primarily looking at the road ahead; • Driver gaze direction is being confirmed as looking at the rear-view mirrors; or, • Driver head movement is confirmed as primarily directed towards the driving task **The specification for confirming these or equally safe criteria must be declared by the manufacturer and supported by documented evidence**	The attentiveness level of the driver is not being used to assess their ability to take control, as there is no definitive requirements for assessing the driver's ability to regain control once the system is engaged. Scenarios such as the driver being distracted (daydreaming, having a medical condition, etc.) are not addressed by the homologation document and are left to the homologating body to decide.
Human Machine Interface/operator information – Information to the driver	The optical signals above shall be adequate in size and contrast. The acoustic signals above shall be loud and clear.	• These requirements, with regards to warning size and loudness, are still open to interpretation depending on the testing authority. • Also the requirement laid out does not account for people with some disabilities such as being colour blind and deaf. In the UK, the DVLA issues license to people who are colour blind or have hearing impairment, treating them in par with any other individual who does not suffer from any one of these. The ALKS regulation, may not necessarily be suitable for such individuals.

Quick start checklists for OEMs and suppliers

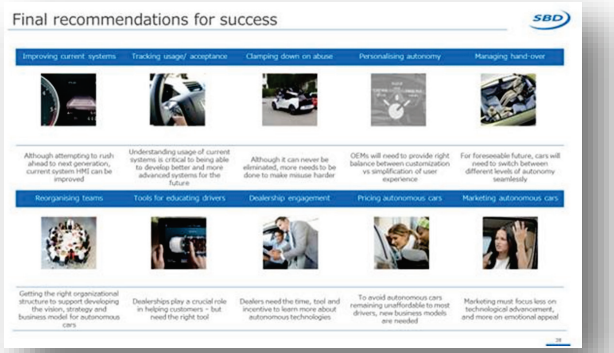
Time is short for getting WP.29 ready – in terms of ALKS, Cyber Security and Software Update requirements. Some OEMs and suppliers may already have some relevant process in place. However, there is likely to be some bridging gap need to make it compliant. For the majority, however, awareness is only now starting to grow and fast action is needed...

Steps	OEMs	Suppliers
1 Raise awareness	❑ Get the organisation committed to higher levels of automation ❑ Establish a WP.29 dedicated team ❑ Start information-sharing with impacted suppliers	❑ Share the key technical requirements with the engineering team ❑ Reach-out proactively to your customers ❑ Create required materials to document WP.29 readiness to your customers
2 Perform a gap analysis	❑ Document your existing ADAS implementation process, capabilities and functional safety process ❑ Compare existing processes with the required safety management process in the regulation ❑ Prepare new supplier requirements for compliance	❑ Benchmark your existing safety rating processes ❑ Develop new product features & functions in accordance with requirements ❑ Update your contracts and service agreements
3 Start a POC	❑ Limit the scope of POC to manageable size or limited features ❑ Validate the system's intended functionality in specific markets through real-world software updates ❑ Initiate mock tests to check compliance	❑ Develop tools to share best practices

SBD's holistic autonomous car support

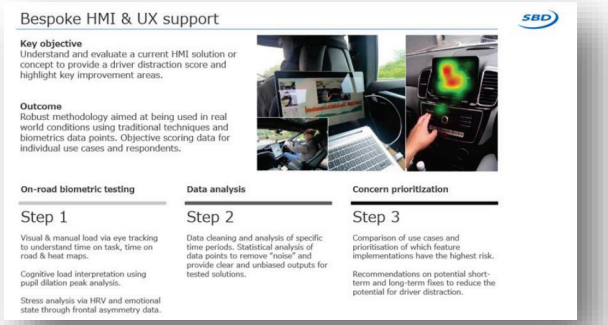
Design

- Supplier sourcing & contract support (RFI / RFQ)
- Validation of design security and early identification of weak points
- ADAS & AV HMI guidelines and best practice UX
- E/E architecture analysis and recommendations



Test

- ADAS HMI user experience/ expert evaluation
- Abuse/misuse testing
- ADAS performance testing
- Degraded mode testing



Strategy

- Competitor benchmarking & market trends
- ADAS & AV trends by OEM and market analysis
- Market-specific regulatory and competitive assessments
- Technical due diligence to support investor decisions

Reports

Autonomous Car Legislation Guide (535)

Autonomous Car Guide (804)

ADAS & Autonomy Database (534)

ADAS & Autonomy Forecast (538)

ADAS HMI Benchmarking (806)

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