WORLD ECONOMIC FORUM

FUTURE NETWORKED CAR SYMPOSIUM | GENEVA

Key barriers and enablers for the safe scaling of L2+/L3 vehicle autonomy

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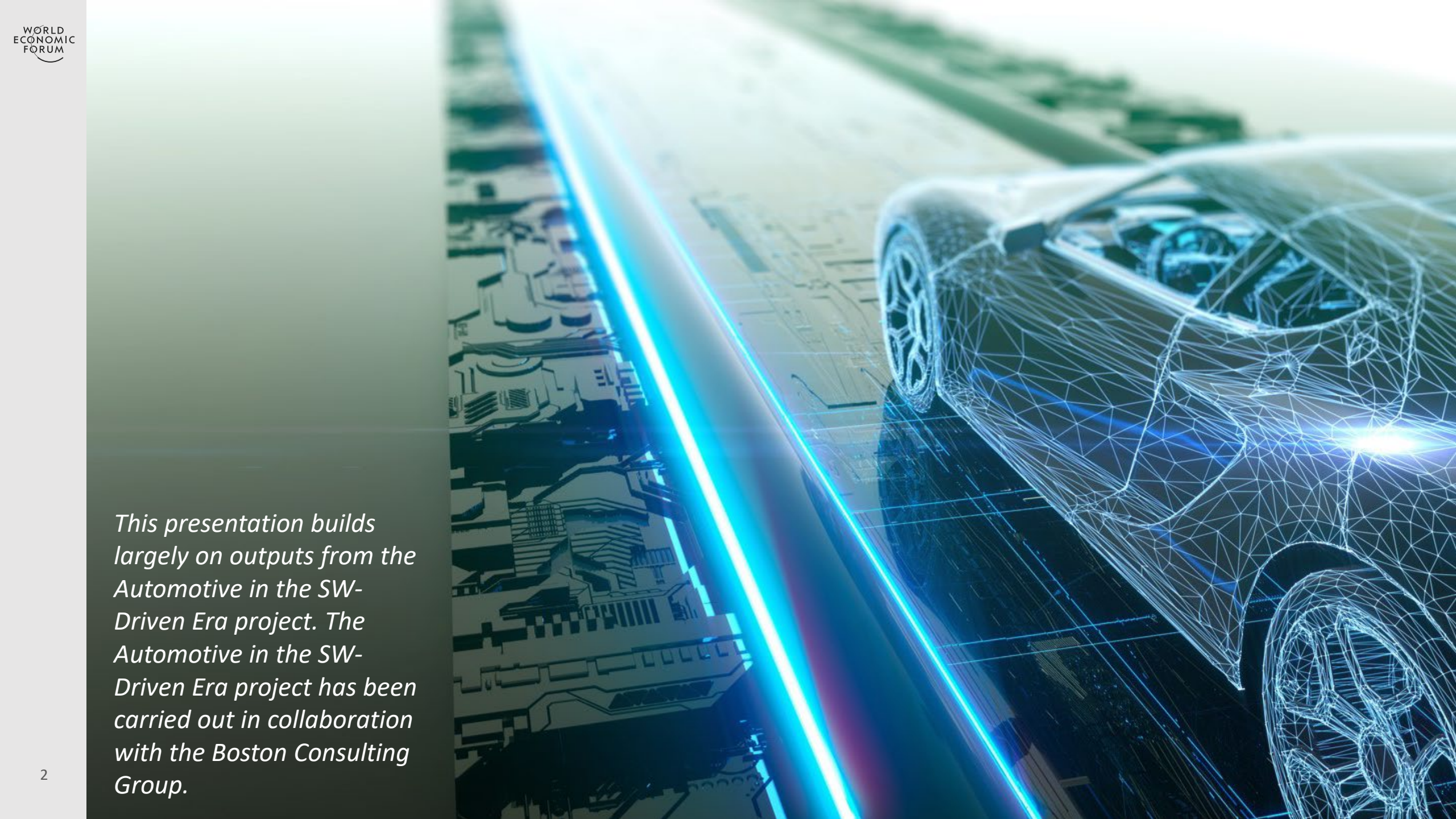
11 March 2024



This presentation builds largely on outputs from the Automotive in the SW-Driven Era project. The Automotive in the SW-Driven Era project has been carried out in collaboration with the Boston Consulting Group.

World leaders face deep and complex shifts

Economic and industrial transformation

Geopolitical transformation

Technological transformation

Cultural and value transformation

The World Economic Forum is the International Organization for Public-Private Cooperation

The world is undergoing deep, complex and accelerated transformation, and neither government, nor business, nor civil society alone can address our common challenges.

PROFESSOR KLAUS SCHWAB
FOUNDER AND EXECUTIVE CHAIRMAN OF THE WORLD ECONOMIC FORUM

ADAS/AD can clearly benefit society …

… of **accidents** occur due to human error

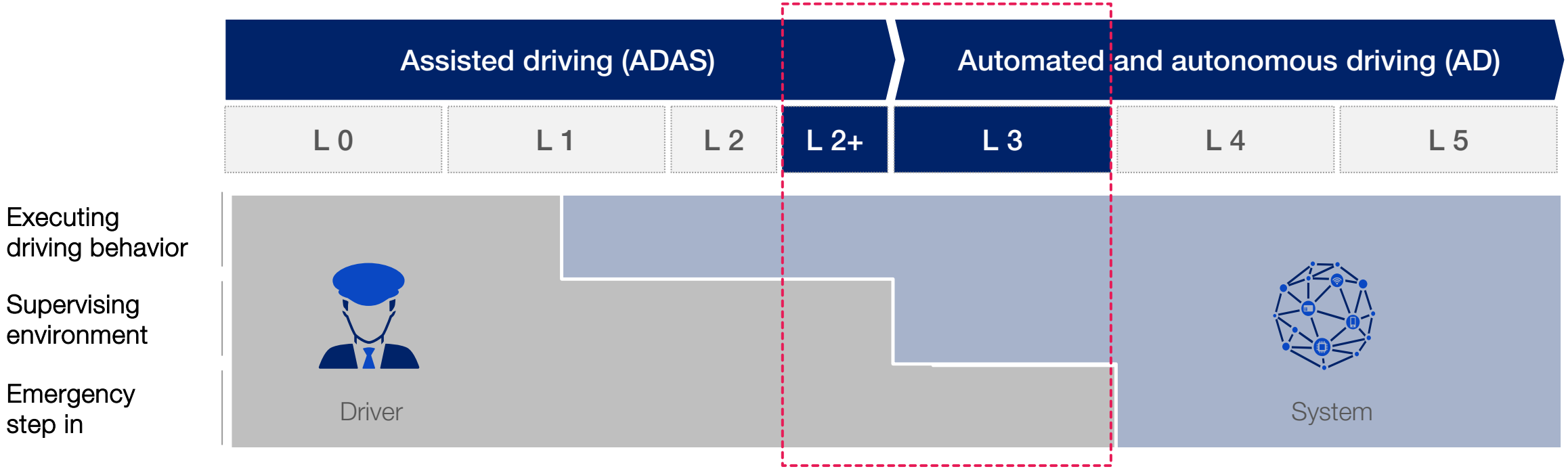
… of **accidents** can be **prevented** by autonomous vehicles[1]

… but these benefits should not be taken for granted

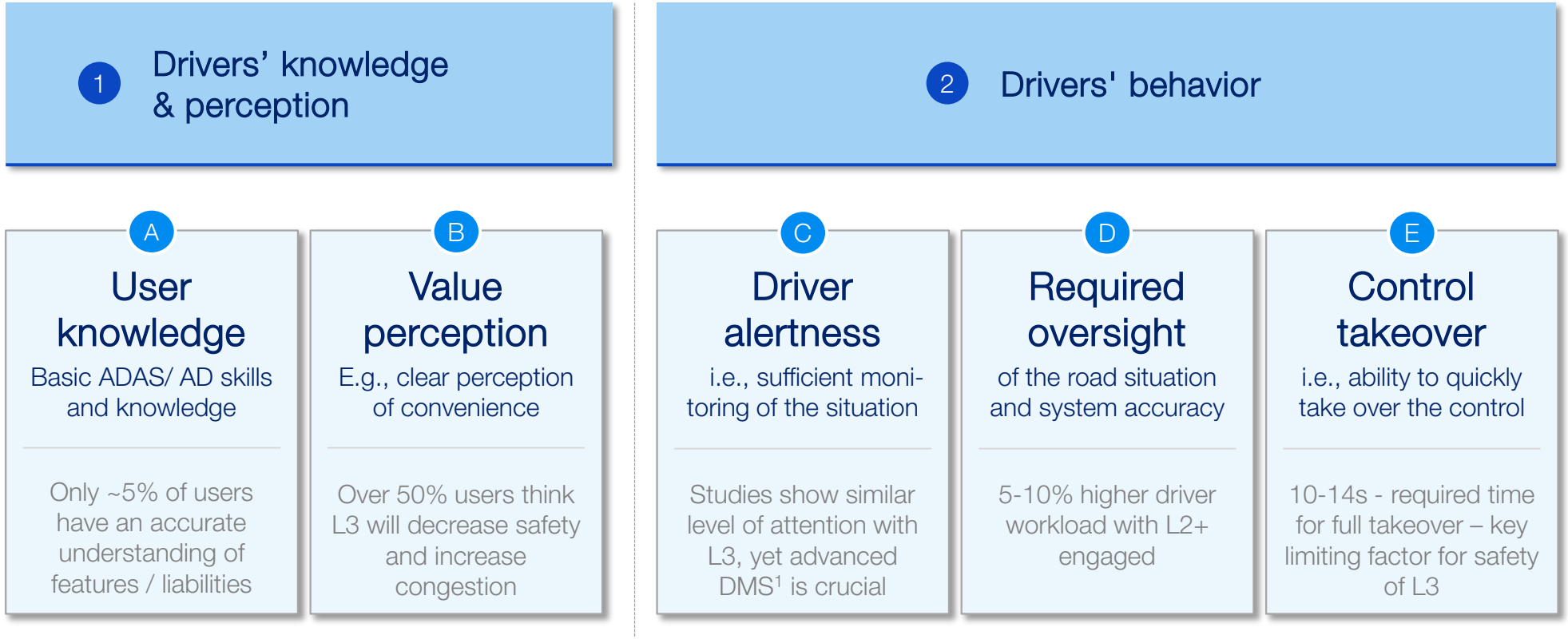
1. 94% of accidents occur due to human failure (e.g., recognition error) and can be prevented by advanced AD algorithms; Source: The National Motor Vehicle Crash Causation Survey (NMVCCS) conducted from 2005 – 2007 (N of incidents = 2,189,000); Goldman Sachs, UBS, IHS, Statista, BCG market model, own calculation.

Collaboration is key

We are on the way to vehicle autonomy, but there is still a (long) journey to full autonomy: we need to leverage the benefits current technology already offers



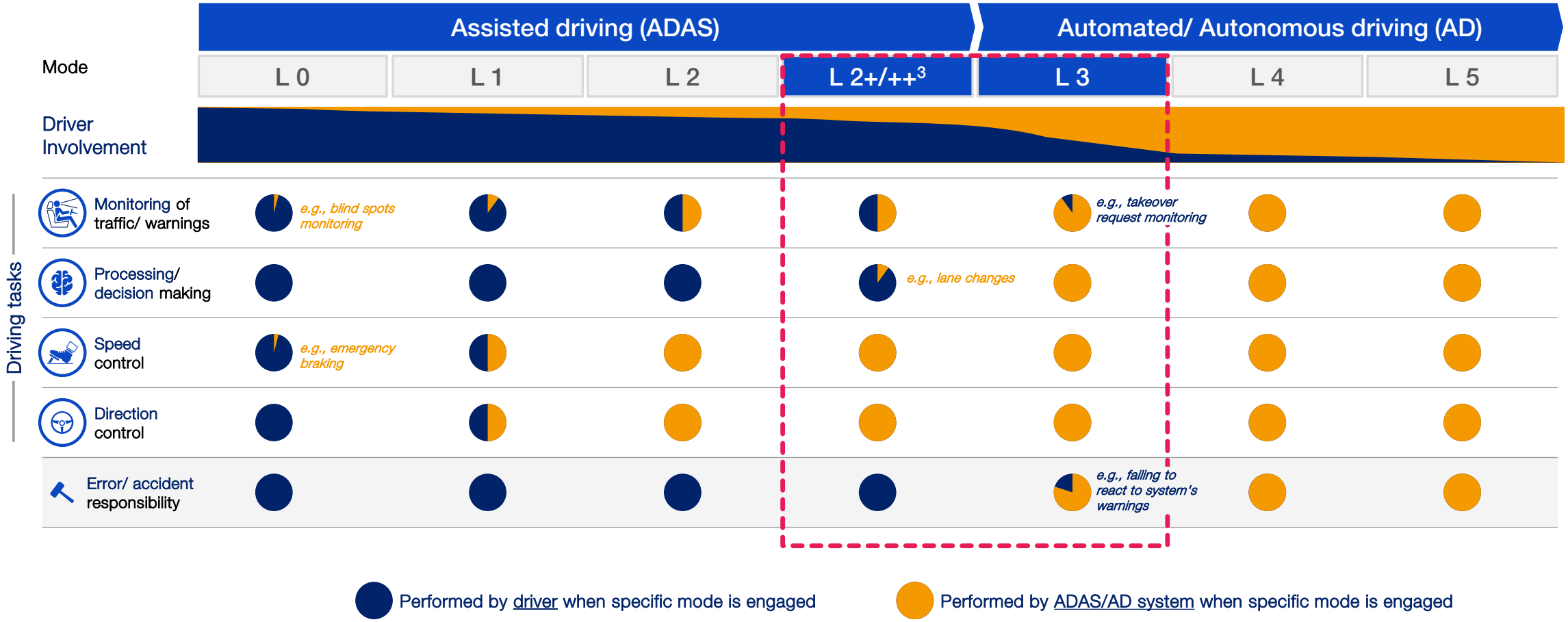
L2+ and L3 vehicle autonomy: which are the key barriers for its safe scaling?



1. DMS – Driver monitoring system

#1: Agree on unified nomenclature and definitions

Current levels are complex – can we simplify?



#1: Agree on unified nomenclature and definitions

ASSISTED driving

AUTOMATED driving

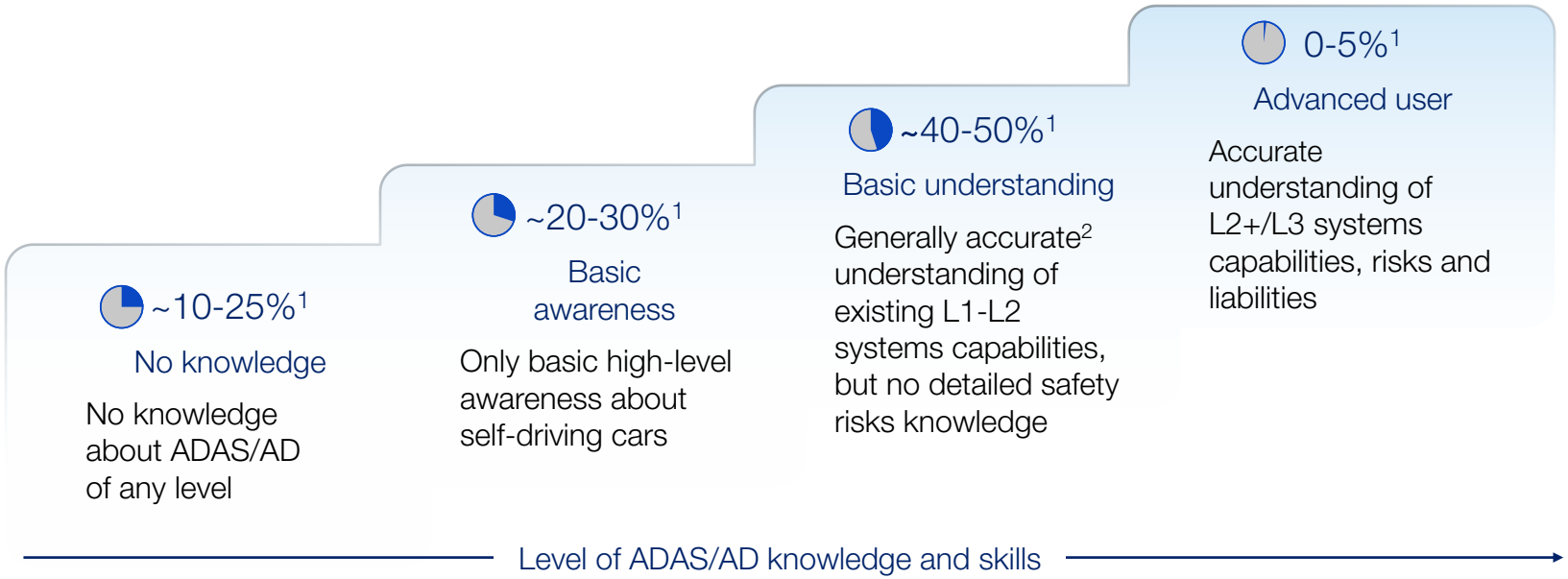
AUTONOMOUS driving

2 key aspects:

- Who is liable?
- Can I be required to take over control?

#2: Establish a holistic user journey

Level of basic understanding and knowledge about L2+/L3



Commentary

- Majority of the users have only a basic understanding about existing autonomy functions
- Knowledge about advanced features is often incorrect (e.g., wrong perception of required driver involvement)

Quotes from participants

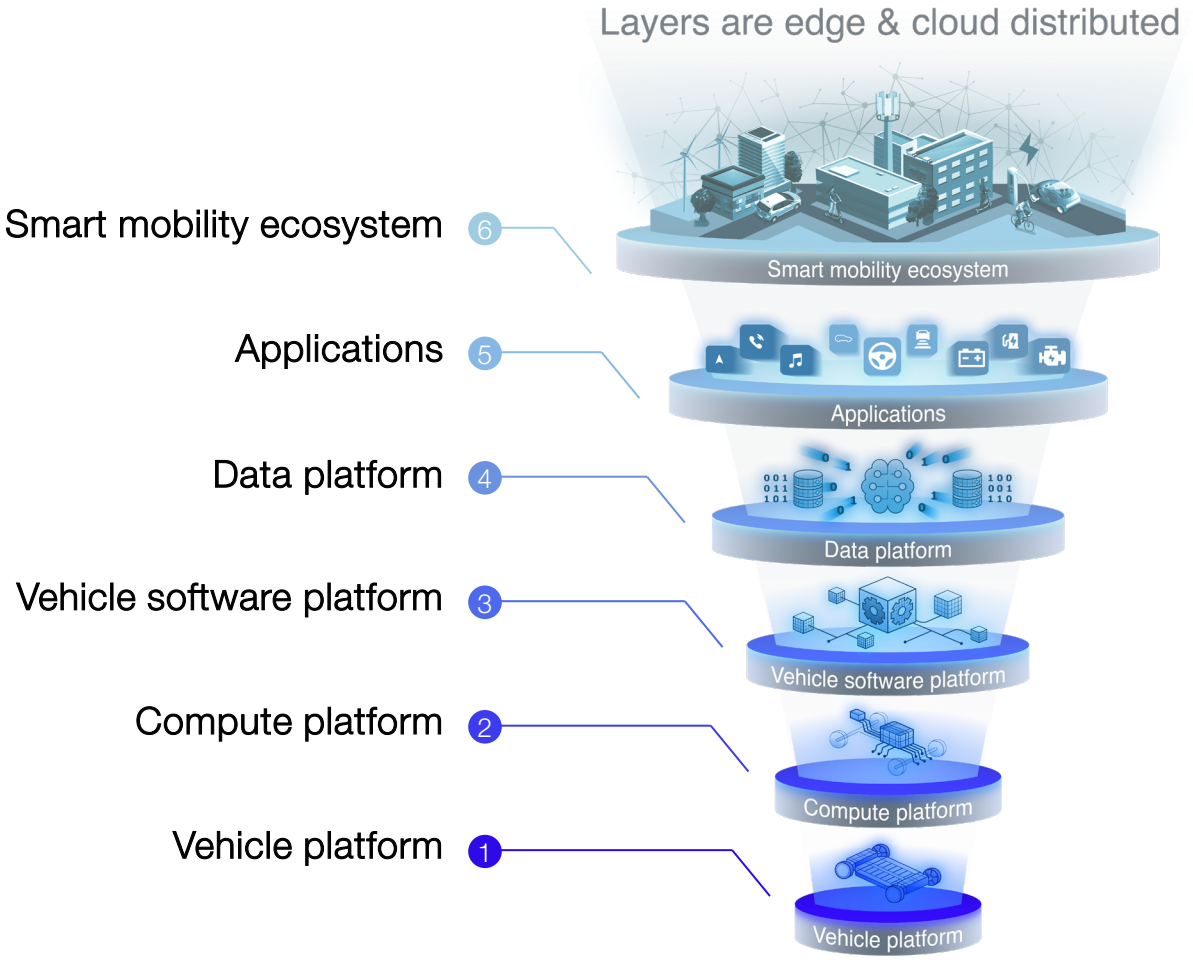
"I think drivers need at least basic introduction on how to use the system, I would expect salesmen to do that"

1. Estimated range based on different studies 2. Based on user's judgment of how system can handle given traffic situation in different scenarios
Source: L3Pilot User acceptance survey (2021), Expectations and understanding of advanced driver assistance systems among drivers, regional surveys UK, US and EU pedestrians, bicyclists, and public transit riders (2021), BCG ADAS Survey and user testing study (2023)

#2: Establish a holistic user journey

Learning to drive	Learning about technology	Getting to know specific vehicle	Driving
Goal			
Understand user's perspective on required training for specific ADAS features	Understand user's knowledge and perspective on technology	Understand user's behavior in real setting when first introduced to L2+/L3	Understand user's behavior in real setting when using L2+/L3 functions
1 Provide specific training	2 Ensure sufficient knowledge	6 Increase transparency to build trust	7 Continue improving tech
	3 Provide clarity on benefits		8 Ease monitoring for driver
	4 Educate about system limit. and against drivers' misuse		9 Focus on key use cases: Highway, traffic jam & parking
	5 Clarify value of L2+ vs L3		10 Address mode confusion problem

#3: Ensure a minimum level of software development and testing unification



Collaboration on the vehicle software platform can result in

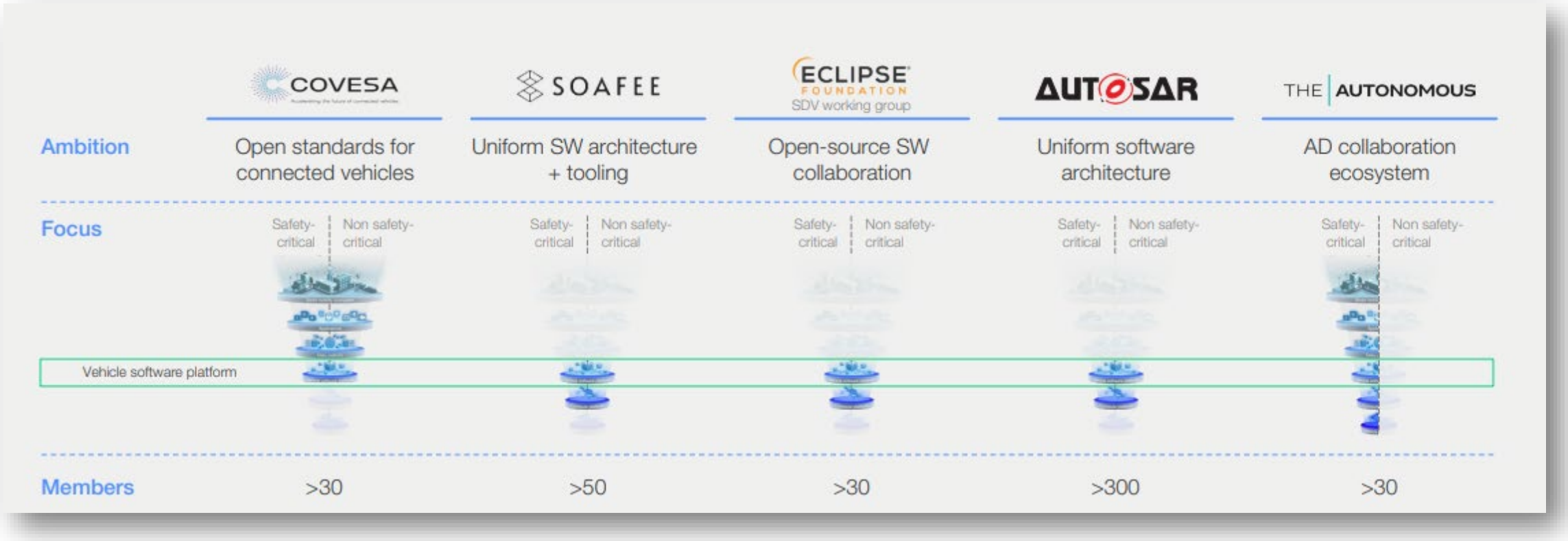
80-90%

Decreased

error rate in software integration[1]

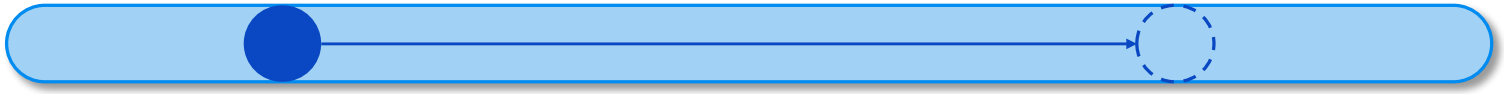
1. Enabled by fewer interfaces and more standards. Source: BCG analysis.

#3: Ensure a minimum level of software development and testing unification



#4: Ensure “safety-by-design”

Driver's responsibility



Safe-by-design

Current state

Target state

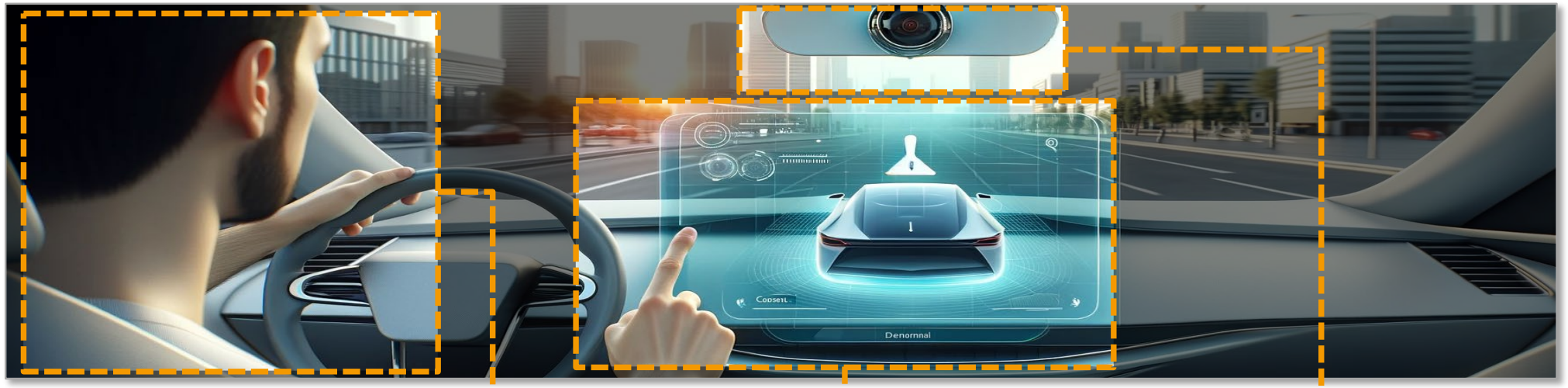
Examples responsibility shift aspects

- **Driver can lose attention on long drive** with ADAS/AD engaged
- **Drivers overwhelmed with different types of notifications** when takeover is required
- Some non-driving related tasks can lead to **increased takeover time**
- Not always clear for the driver **which ADAS/AD mode is engaged**

- **System insures the driver is always ready** to takeover via smart DMS and notification logic
- **Notifications are unified to be understood by the driver** in split second
- **Takeover time is maximized to ensure safe takeover** in all conditions
- **Simple & unified mode indications** making driver always aware about current ADAS?AD mode

#5: Define a shared approach for human-machine interaction

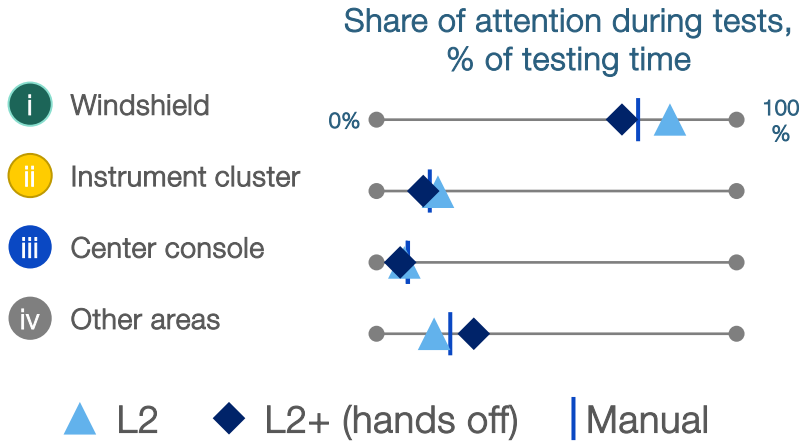
How can industry improve safety and unlock the full potential of car-driver interaction?



Challenge	Driver's understanding of what car does/ sees/ thinks	Efficient car-to-driver communication	System's understanding of what the driver does/ sees

#5: Define a shared approach for human-machine interaction

Impact of hands-off driving on attention distribution



- Studies suggest that in combination with proper glance-based Driver Monitoring System (DMS) L2+ system usage does not lead to significantly decreased level of attention to the situation on the road
- However long-term risks are yet insufficiently studied and potential system misuse can be more common in real application vs. testing environment
- Additionally, the actual cognitive attention for traffic monitoring (even if the drivers' glance is monitored) needs to be studied

Source: VDA/FKA report, 1. HMI – Human-machine interaction, BCG ADAS Survey and user testing study (2023)

Commentary

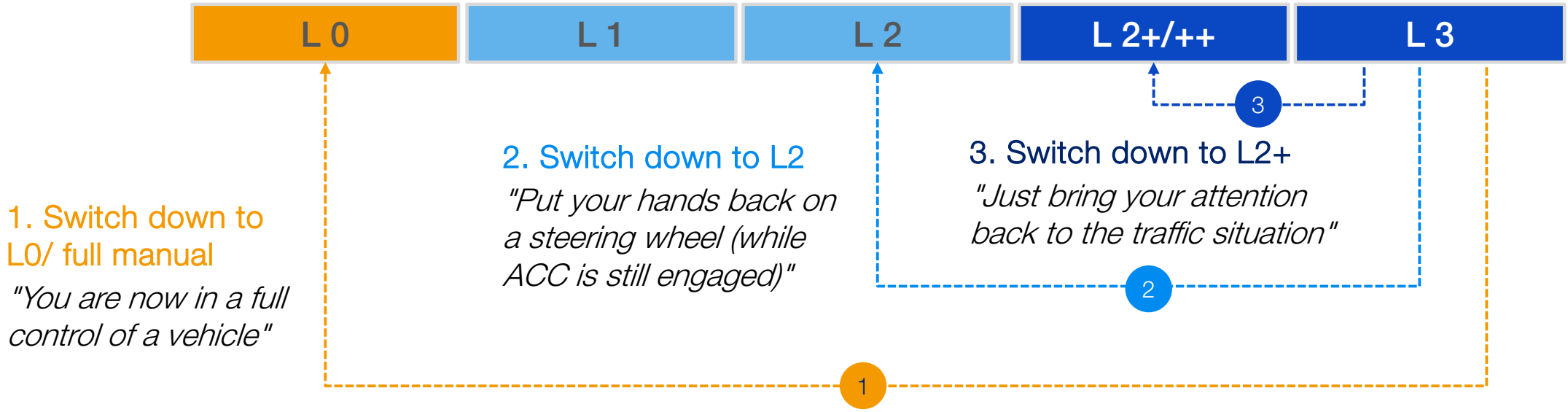
- Further development of DMS and HMI is crucial for L2+/L3 safe scaling and misuse avoidance

Quotes from participants

"Even with standard cruise control I get easily distracted, I think with hands off it becomes even more obvious"

#5: Define a shared approach for human-machine interaction

How to ensure clarity of modes changes for the driver (several scenarios need to be clear to driver)?



* Not exhaustive set of scenarios

Summary | Five key action areas for safe scaling of ADAS/ AD

#1 Agree on unified nomenclature and definitions

#2 Establish a holistic user journey

#3 Ensure a minimum level of software development and testing unification

#4 Ensure “safety-by-design”

#5 Define a shared approach for human-machine interaction

DRIVE-A Initiative

Automotive in the SW-Driven Era

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