



**VOLKSWAGEN**

AKTIENGESELLSCHAFT



**AdaptiVe**

*Automated Driving Applications and  
Technologies for Intelligent Vehicles*

Aria Etemad  
Volkswagen Group Research

*An Introduction to Automated Driving*

Brussels  
24 April 2015



# // 29 partners



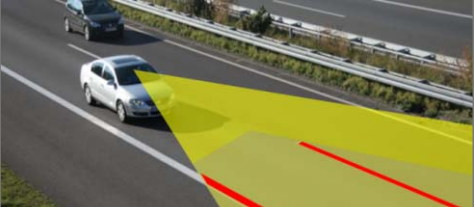
# // Examples of driver assistance systems

**Longitudinal control**



City Break Assist  
ACC & Front Assist

**Lateral control**




Side Assist  
Lane Assist

**Park assist systems**




Park Assist Park Pilot  
Rear Assist

**Light**



Light Assist


**Recommendation**



Müdigkeit erkannt.  
Bitte Pause.

Pause  
Recommendation

**Driver information**



Sign Assist  
Verkehrszeichen

120 80

Sign Assist

# // Examples for automated driving - industrial projects

Bertha Benz drive



© Daimler

2013 Mercedes

Traffic jam pilot



© Audi

2012 Audi

Motorway pilot



© BMW

2011 BMW

Google car



© Google

2011 Google

Pikes Peak



© Audi

2010 Audi

Junior



© VW

2007 VW

# // Examples for automated driving - funded projects

## eT!: Follow me!



2011 eT! (BMU)

## AutoNOMOUS



2011 FU Berlin (BMBF)

## Emergency stop assistance



2011 SmartSenior (BMBF)

## Temporary auto pilot



2011 HAVEit (EU)

## Platooning



2012 Sartre (EU)

## Parking and charging



2011-2015 V-Charge (EU)

# // Motivation for automated driving functions

*Zero  
emission*

Reduction of fuel consumption & CO<sub>2</sub> emission  
Optimization of traffic flow



*Demographic  
change*

Support unconfident drivers  
Enhance mobility for elderly people

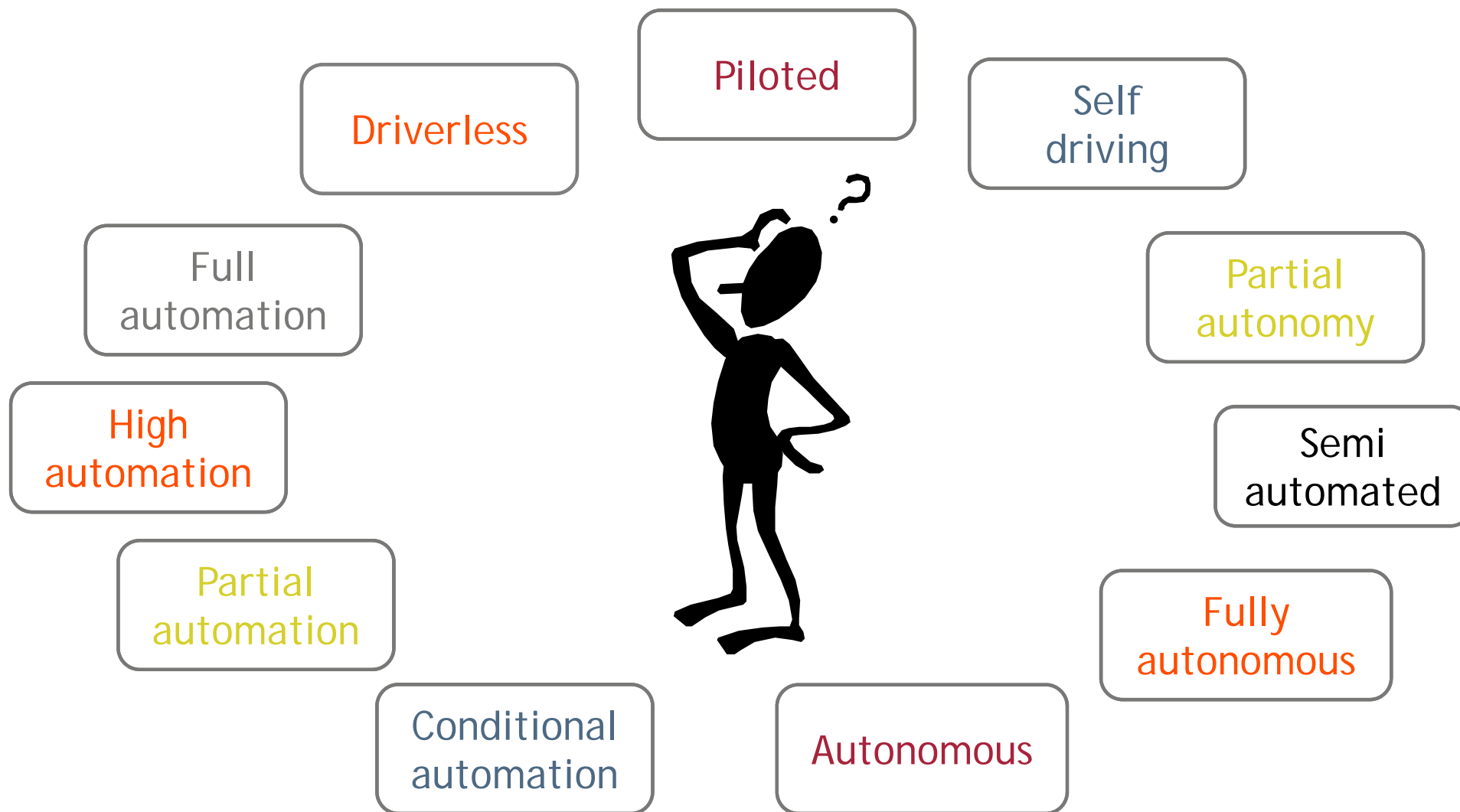


*Vision zero*

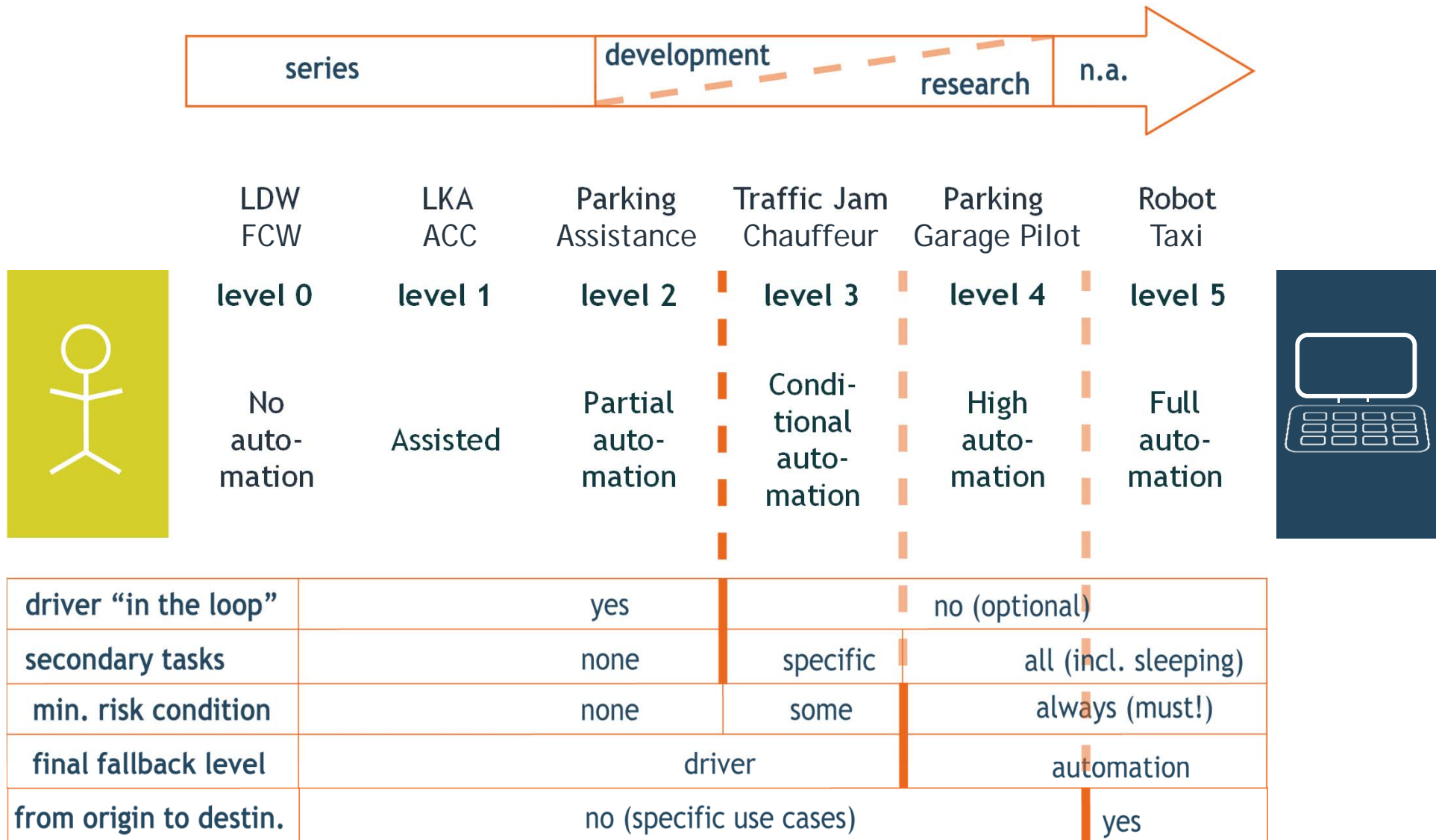
Potential for more driver support by avoiding  
human driving errors



# // Terms related to automated driving



# // Levels of driving automation acc. to SAE and VDA



Source: SAE document J3016, "Taxonomy and Definitions for Terms Related to On-Road Automated Motor Vehicles", issued 2014-01-16, see also [http://standards.sae.org/j3016\\_201401/](http://standards.sae.org/j3016_201401/)



# // Introduction scenario

ACC: Adaptive Cruise Control  
 LKA: Lane Keep Assist

LDW: Lane Departure Warning  
 FCW: Forward Collision Warning

2	Partial automation		<div style="background-color: #2c4e64; color: white; padding: 5px; text-align: center;">Parking assistant</div> <div style="background-color: #2c4e64; color: white; padding: 5px; text-align: center;">Traffic jam assist.</div>
1	Assisted	<div style="background-color: #2c4e64; color: white; padding: 5px; text-align: center;">ACC</div> <div style="background-color: #2c4e64; color: white; padding: 5px; text-align: center;">LKA</div>	<div style="background-color: #2c4e64; color: white; padding: 5px; text-align: center;">City Cruise</div> <div style="background-color: #2c4e64; color: white; padding: 5px; text-align: center;">Constr. site ass.</div>
0	No automation	<div style="background-color: #2c4e64; color: white; padding: 5px; text-align: center;">LDW</div> <div style="background-color: #2c4e64; color: white; padding: 5px; text-align: center;">FCW</div>	
		<i>ADAS today</i>	<i>ADAS tomorrow</i>

# // Introduction scenario

3	Conditional automation			Traffic Jam Chauffeur
2	Partial automation		Parking ass. Traff. jam a.	
1	Assisted	ACC LKA	City Cruise Constr. ass.	
0	No automation	LDW FCW		
		<i>ADAS today</i>	<i>ADAS tomorrow</i>	<i>Automation Gen. 1</i>

# // Introduction scenario

4	High				Parking garage pilot
3	Conditional automation			Traffic jam chauffeur	Highway chauffeur
2	Partial automation		Parking ass. Traff. jam a.		
1	Assisted	ACC LKA	City Cruise Constr. ass.		
0	No automation	LDW FCW			
		<i>ADAS today</i>	<i>ADAS tomorrow</i>	<i>Automation Gen. 1</i>	<i>Automation Gen. 2</i>

# // Introduction scenario

5	Full automation					Robot Taxi
4	High automation				Parking garage Pilot	
3	Conditional automation			Traf. J. Cha. City Chauff.	Highway Chauffeur	
2	Partial automation		Parking ass. Traff. jam a.			
1	Assisted	ACC LKA	City Cruise Constr. ass.			
0	No automation	LDW FCW				
		<i>ADAS today</i>	<i>ADAS tomorrow</i>	<i>Automation Gen. 1</i>	<i>Automation Gen. 2</i>	<i>n.a.</i>

# // Challenges and objectives

Widespread application of automated driving to improve traffic safety, efficiency and comfort



## // Possible side effects

<b>Altered driver state</b>	<ul style="list-style-type: none"><li>• Drowsiness</li><li>• Reduced situation awareness</li></ul>	<ul style="list-style-type: none"><li>• Overreliance</li><li>• Misuse</li></ul>	<b>Inappropriate trust in automation</b>
<b>System understanding</b>	<ul style="list-style-type: none"><li>• Mode confusion</li><li>• Mental model</li></ul>	<ul style="list-style-type: none"><li>• Loss of skills</li><li>• Behavioural adaptation</li></ul>	<b>Long term effects</b>

# // Demonstrators



Parking assistance,  
garage, special areas,  
multi-level garage,  
Stop & go

City cruise, City chauffeur,  
Supervised city control

Enter & exit highway,  
following lane, lane-  
change, filter-in,  
overtaking, danger spot  
intervention, Stop & go

Safe stop



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# Adapt:Ve

*Automated Driving Applications and  
Technologies for Intelligent Vehicles*

*Thank you.*

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