Piloting Automated Driving on European Roads

IEDAS 2018

Ingolstadt, 24.10.2018

Raisch, BMW Group

Naujoks, BMW Group


L3Pilot
Driving Automation
1,000
drivers
100
cars
10
countries

Facts.

Supported by

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723051.

€68 million BUDGET

48 months DURATION, starting in September 2017

€36 million FUNDING

34 PARTNERS, among them OEMs, suppliers, research, SMEs, insurers, authorities and user groups

12 COUNTRIES involved: Austria, Belgium, France, Finland, Germany, Greece, Italy, Netherlands, Norway, Sweden, Switzerland, UK

Partners.

OEMs

VOLKSWAGEN AKTIENGESELLSCHAFT

BMW GROUP

FCA FIAT CHRYSLER AUTOMOBILES | CRF

DAIMLER

Ford

PSA GROUPE

GROUPE RENAULT

HONDA The Power of Dreams

JAGUAR

LAND ROVER

TOYOTA

VOLVO

Suppliers

Autoliv

DELPHI

FEV

SMEs

ADAS Management-Consulting Advanced Driver Assistance and Safety

eict

Researchers

bast

DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center

ICCS

ika INSTITUT FÜR KRAFTFAHRZEUGE RWTH AACHEN UNIVERSITY

CHALMERS UNIVERSITY OF TECHNOLOGY

SNF CENTRE FOR APPLIED RESEARCH AT NHH

TNO innovation for life

UNIVERSITÀ DEGLI STUDI DI GENOVA

UNIVERSITY OF LEEDS

VTT

WIVW

WMG THE UNIVERSITY OF WARWICK

Insurers

Allianz

Swiss Re

Authority

RDW

User group

FIA

L3Pilot Driving Automation

From euroFOT to L3Pilot.

L3Pilot Driving Automation

Objectives

1,000 drivers 100 cars 10 European countries Piloting Automated Driving on European Roads.

Methodology

Data

Evaluation

Fleet

Piloting

Code of Practice

PREPARE DRIVE EVALUATE


Traffic Jam


Motorway


Parking


Urban

Pilot across Europe.

CROSSBORDER	
Austria	Germany
Austria	Italy
Belgium	Germany
Belgium	Netherlands
Finland	Sweden
France	Germany
Germany	Netherlands

COUNTRY / REGION / OEM	
BE / Brussels / NL	Toyota
DE / Aachen	Ford
DE / Munich	BMW
DE / Offenbach	Honda
DE / Wolfsburg	VW
FR / Paris and other regions	REN / PSA
IT / Turin and Trento	CRF
LU / NL	Delphi
SE / Gothenburg	Volvo
UK / Coventry	JLR

SP2 „Code of Pratice“.
Objectives, Partners & History.

Provide a comprehensive guideline with best practices for the development of functions: **Code of Practice** for automated driving.

- Collect best practices on relevant topics.
- Describe a typical process for an automated driving function.
- Include hands-on checklists.
- Include safety aspects and methods to confirm a safe operation of automated driving functions.

Partners: Daimler (Lead), BMW, CRF, Ford, Jaguar Land Rover, Opel, PSA, Renault, Toyota, Autoliv, Aptiv, RWTH Aachen Universtiy (ika)

PReVENT:
RESPONSE 3 „CoP ADAS“
2008

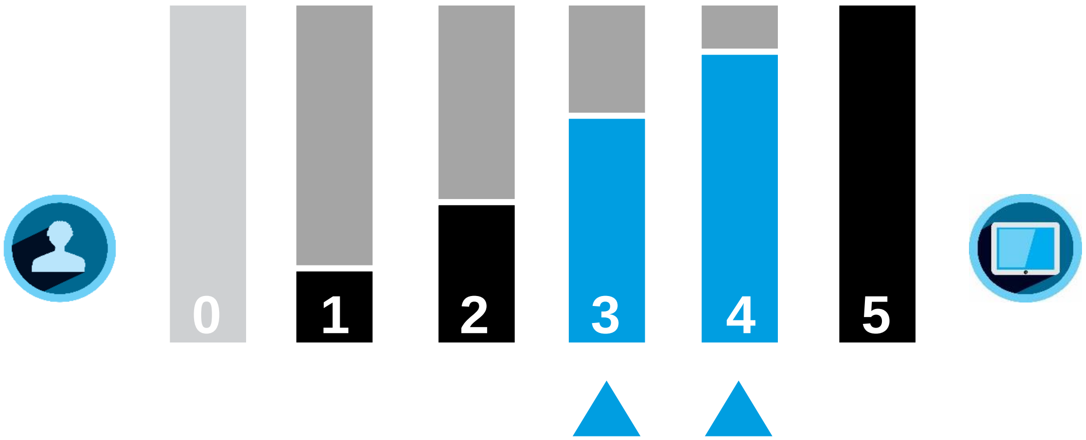
AdaptIVe:
Response 4 „Legal aspects AD“
2014 2017

L3Pilot:
„Code of Practice AD“
2017 2021

Scope of the CoP-AD.

According to SAE document J3016, “Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles”, revised 2016-09-30, see also http://standards.sae.org/j3016_201609

Europe



Motorway & Parking

Extent to selected non-EU regions

Extent to selected level 4/5 robot taxi applications

Extent to driving scenarios in urban / rural environment

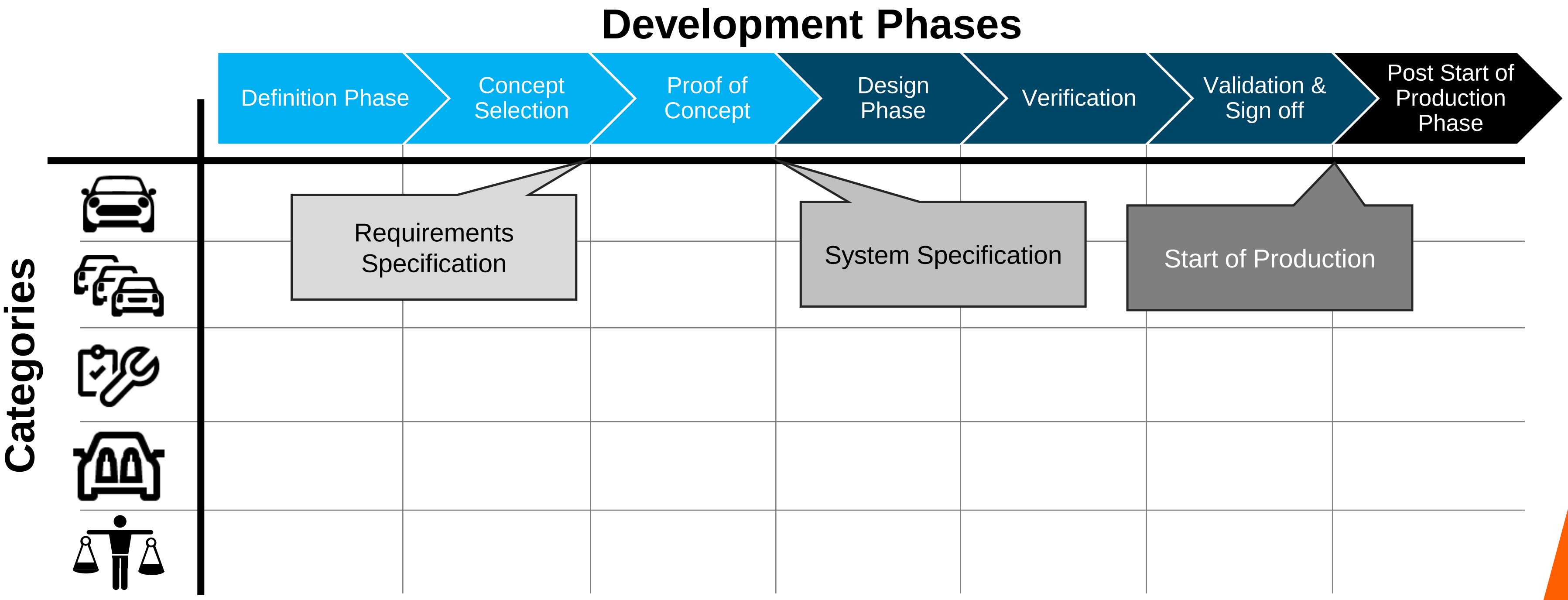
Categories of the CoP.

- **Categories of the CoP according to D2.1 „Code of Practice Framework“[1]:**

Operational Design Domain Vehicle Level	Operational Design Domain Traffic System Level	Safe Guarding Automation	Human-Machine Interaction	Behavioral Design
Function description, system limits, test-/ scenario catalogue	Remote assistance, V2X, MRM etc.	Functional safety, cyber security, SOTIF, updates (e.g. over the air) etc.	Provide guidelines for HMI, mode awareness/ confusion, controllability etc.	Traffic safety (mixed traffic), references to Ethics

1: S. Wolter, A. Knapp, V. Jütten, M. Chen, F. Bonarens, U. Eberle, O. Schädler, Code of Practice Framework, L3Pilot Deliverable D2.1, 2018

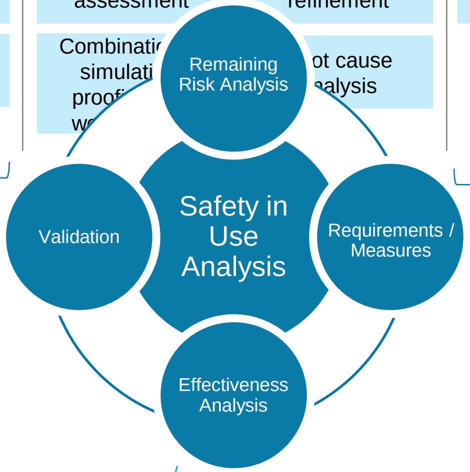
Code of Practice Framework.



Example 1: Safe Guarding Automation.
SOTIF - Safety in Use Analysis.

Development Phases

	Definition Phase	Concept Selection	Proof of Concept	Design Phase	Verification	Validation & Sign off	Post Start of Production Phase
SOTIF	Function / System safety requirements	Architecture selection	Trigger events assessment	Functionality refinement	Testing of functionality	Safety validation	Field Operational Test
⋮	Safety in Use analysis	Fallback strategy	Combinatic simulati proofi w	ot cause alysis			



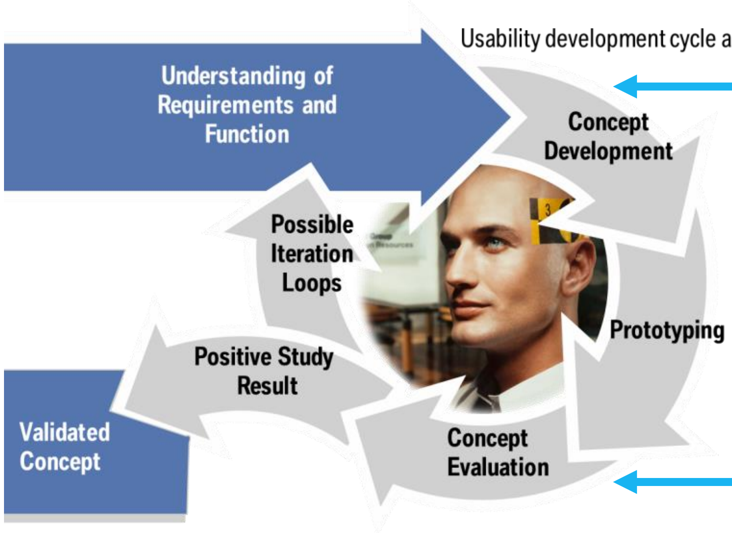
Finding safety use cases (foreseeable (mis-)use)

V&V methods to prevent unintended (mis-)use

Field observation

Example 2: Human-Machine Interaction.
L3 HMI Checklist.

- **Goal**: Establishment of a comprehensive and easy-to-use checklist to assess the compliance of HMIs of AVs with most important best practices and standards



Guiding of concept development

HMI Checklist

Evaluation of compliance

Definition of scope
- Compliance with basic HMI requirements

Literature review & checklist compilation
- Standards: ISO, SAE…
- Best practices: Guidelines
- Research papers
- Checklist compilation

Quality check and refinement
- Pilot testing
- Rater reliability

L3 HMI Checklist.
Summary of checklist topics.

Evaluation-Criterion

Level of information processing	Noticing the message	Information processing	Action selection	Action implementation
Corresponding items of expert evaluation checklist	– Indications of system mode – Display installation and information presentation – Design of auditory and vibrotactile messages	– Legibility – Colour coding – Understandability – Design of warning messages	**Out of scope of expert assessment**	

L3Pilot Driving Automation

L3 Code of Practice

L3 HMI Checklist.
Expert Assessment Test Procedure - Checklist items.

<table>
<tr><th>Area / purpose</th><th>Item</th></tr>
<tr><td rowspan="3">Operational principles:
- System operation controlled by driver
- Necessary mode indicators are present in the HMI</td><td>Guideline #1: Unintentional activation and deactivation should be prevented.</td></tr>
<tr><td>Guideline #2: The system mode should be continuously displayed.</td></tr>
<tr><td>Guideline #3: Mode changes should be effectively communicated.</td></tr>
<tr><td rowspan="3">Display installation and information presentation
- Displays are mounted at suitable positions
- Visual workload of information search is minimized</td><td>Guideline #4: Visual interfaces used to communicate system states should mounted to a suitable position and distance. High-priority information should be presented close to the driver’s expected line of sight</td></tr>
<tr><td>Guideline #5: HMI elements should be grouped together according to their function.</td></tr>
<tr><td>Guideline #6: Time-critical interactions with the system should not afford continuous attention.</td></tr>
<tr><td>…</td><td>…</td></tr>
<tr><td rowspan="3">Colour coding:
- Promoting intuitive understanding
- Avoiding colour blindness issues</td><td>Guideline #13: Not more than five colours should be consistently used to code system states (excluding white and black).</td></tr>
<tr><td>Guideline #14: The colours used to communicate system states should be in accordance with common conventions and stereotypes.</td></tr>
<tr><td>Guideline #15: Design for colour-blindness by redundant coding and avoidance of red/green and blue/yellow combinations.</td></tr>
</table>

L3 HMI Checklist.
Example: Colour Coding.

- ***Guideline #15: Design for colour-blindness by redundant coding and avoidance of red/green and blue/yellow combinations.***

“Redundant coding is required (e.g. in case of colour-blind people).”	[18], S.48, NFR4A_UNI.4
“Red/green combinations are avoided. Blue/yellow colour combinations are avoided.”	[17], S.13
“Red/Green and Blue/Yellow codings should be avoided. Combinations of Blue and Red from the extreme end of the visible spectrum should also be avoided.”	[11], S.338
“Red/green and blue/yellow combinations should be avoided since these colour combinations might be confusing for people who are colour blind.”	[15], S.21

[11]: Ross, T., Midtland, K., Fuchs, M., Pauzié, A., Engert, A., Duncan, B., Vaughan, G., Vernet, M., Peters, H., Burnett, G., May, A.: Design Guidelines Handbook: Human Factors Guidelines for Safety Presentation by ATT Systems (1996)
[15]: Stevens, A., Quimby, A., Board, A., Kersloot, A., Burns, P.: Design Guidelines for safety in-vehicle information systems (2002)
[17]: Stevens, A., Cnyk, S.: Checklist for the assessment of in-Vehicle information systems, Research Laboratory (2011)
[18]: AdaptIVe D3.3 (2017)

L3Pilot
Driving Automation

Thank you for your kind attention.

Florian Raisch, BMW

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