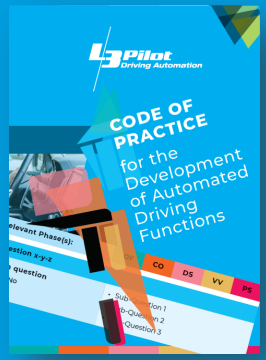
Code of Practice for the development of Automated Driving Functions

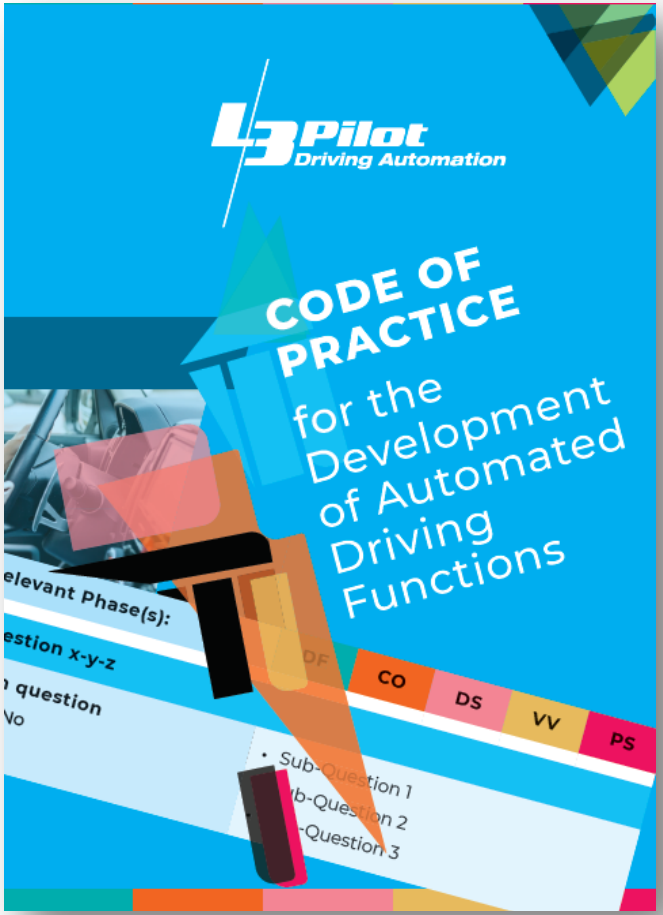
L3Pilot Final Event



Yves Page, Renault

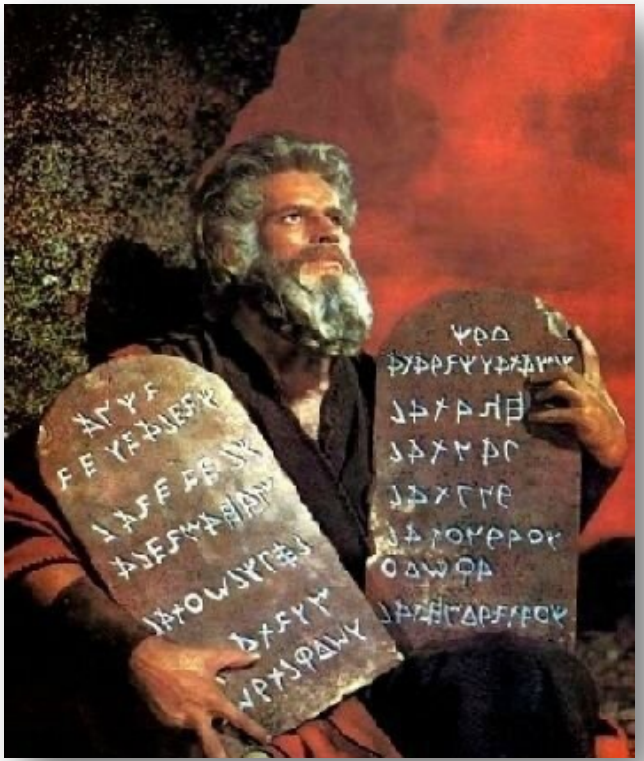
On behalf of all co-authors (Yu, Thibault, Felix, Moritz, Frederik, Fabio, Stefan, Andreas, Jorge, Giancarlo, Elias, Michele, Silvia, Qi, Oliver, Adam, Stuart, Johannes, Frank, Ulrich, Roland, Elisabeth)

Foreword(s)



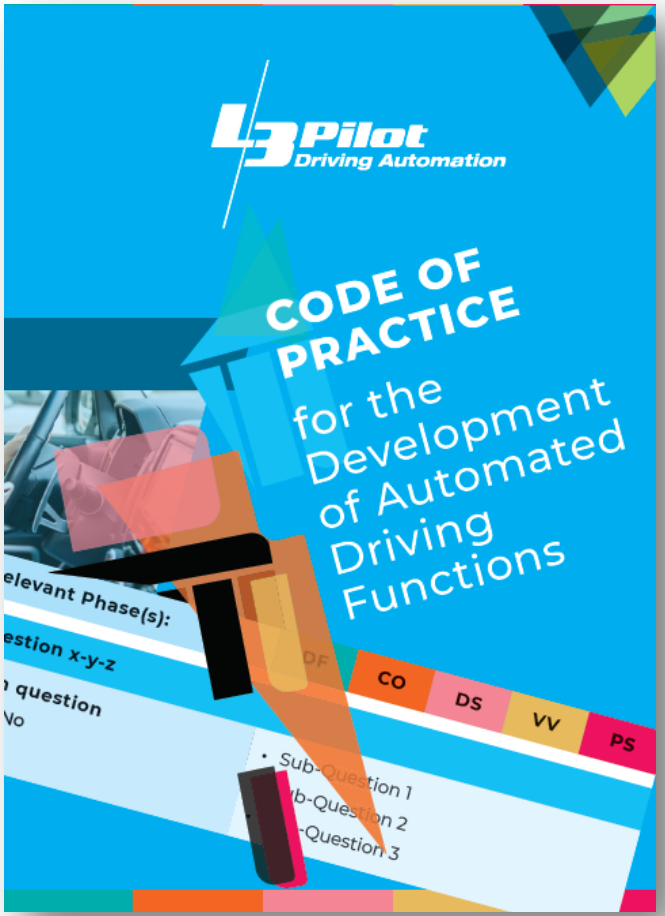
- What do we mean by “Code” ?
- What do we mean by “Code of Practice”?

Foreword(s)



- What is a Code?
  - A **set of rules** of behaviour, **practices** or **conventions** in society, formalised or not (e.g. dress code)
  - A **document** (book or other) where these rules are written (e.g. mining code)
  - An **algorithmic rule** for converting pieces of data into another form or representation, possibly for confidentiality purposes (e.g. selecting the first letter of each word) the result of applying this rule to an item of information.

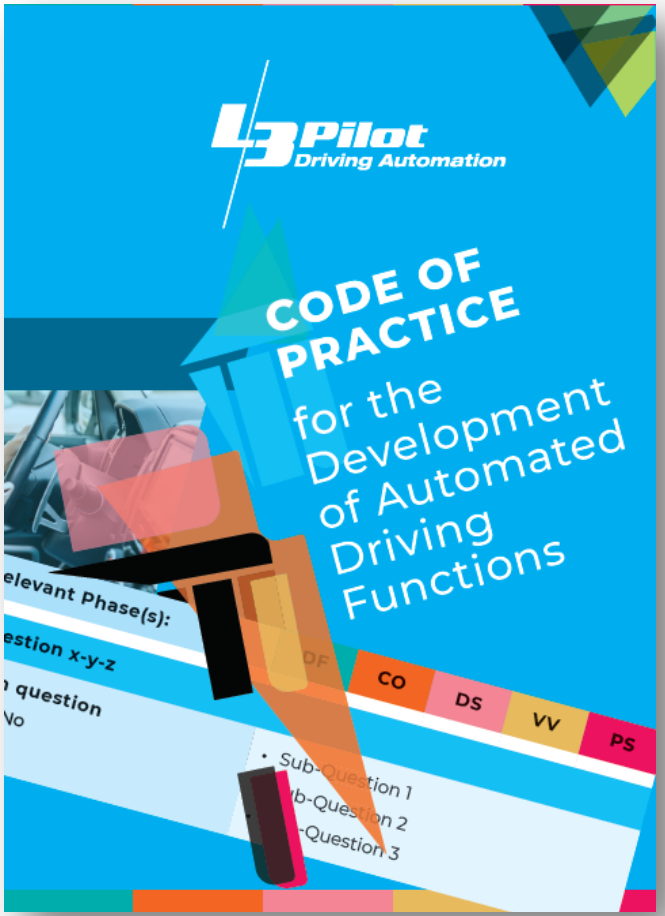
Foreword(s)



- What do we mean by “Code” ?

A document (book or other) where **good practices** are written

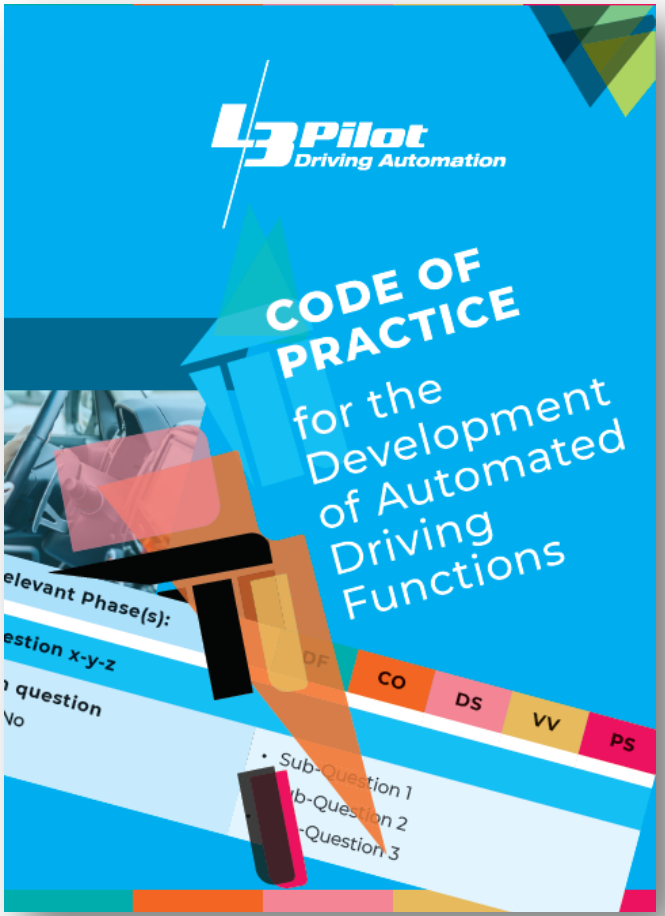
Foreword(s)



- What do we mean by “Code of Practice” ?

The Code of Practice for the Development of Automated Driving Functions provides comprehensive guidelines for supporting the design, development, verification and validation of automated driving technologies.

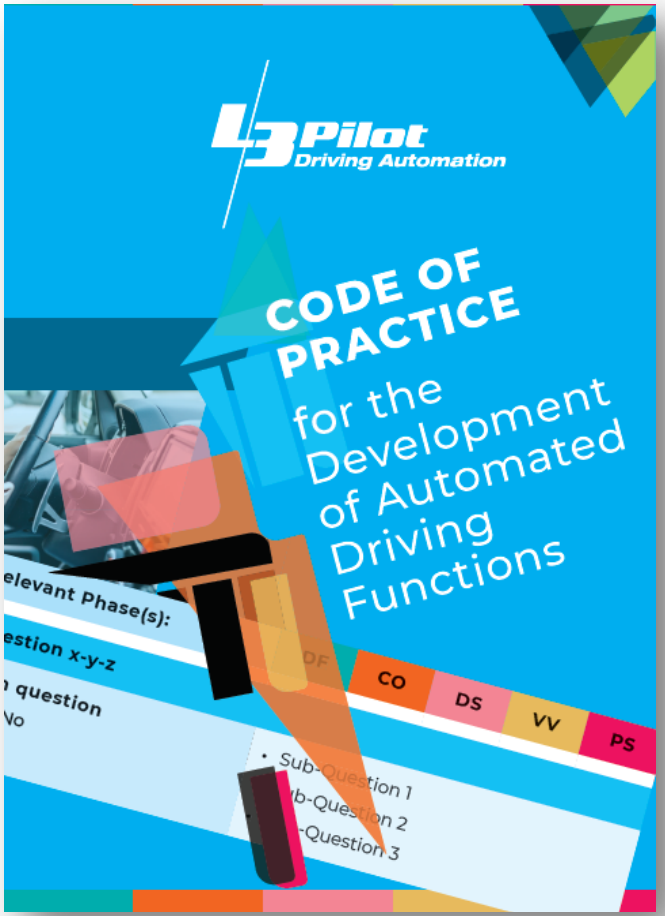
Foreword(s)



- What do we mean by “Code of Practice” ?

1. Collection of best practices
2. Typical process for the development and release of ADF
3. Safety aspects and methods to confirm a safe operation of ADF
4. Checklists, references

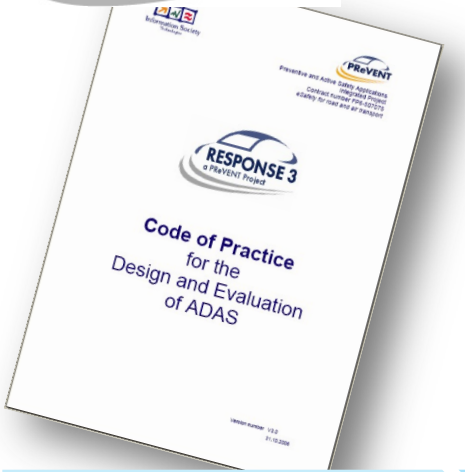
CoP-ADF



- Do we start from scratch ?

No, the story commenced in the 2000s

RESPONSE 3
a PReVENT Project



AdaptIVe

L3Pilot
Driving Automation

PReVENT
RESPONSE 3 „CoP ADAS“
2008

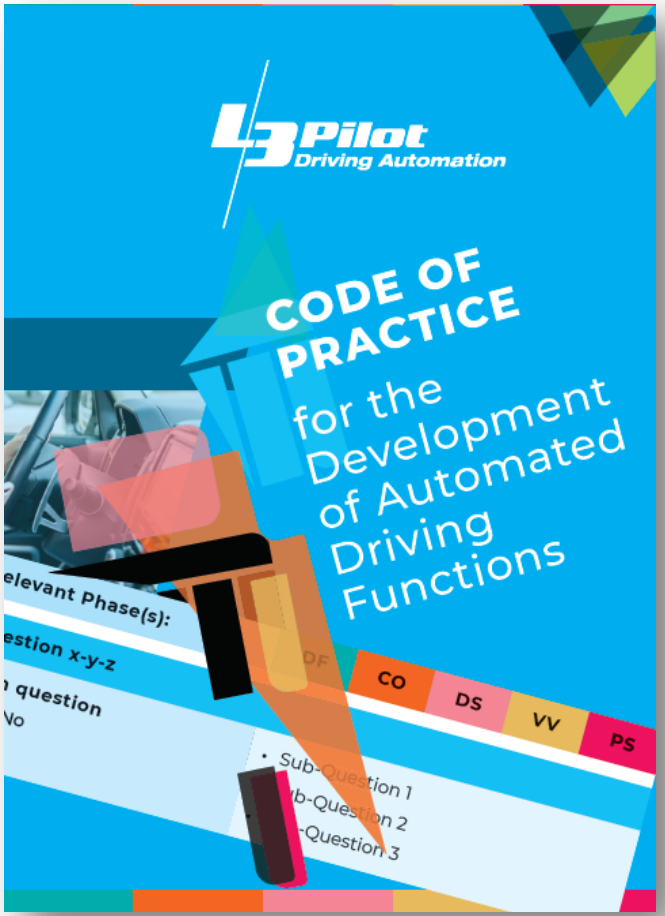
AdaptIVe
Response 4 „Legal aspects AD“
2014 **2017**

L3Pilot
„Code of Practice AD“
2017 **2021**

L3Pilot Driving Automation

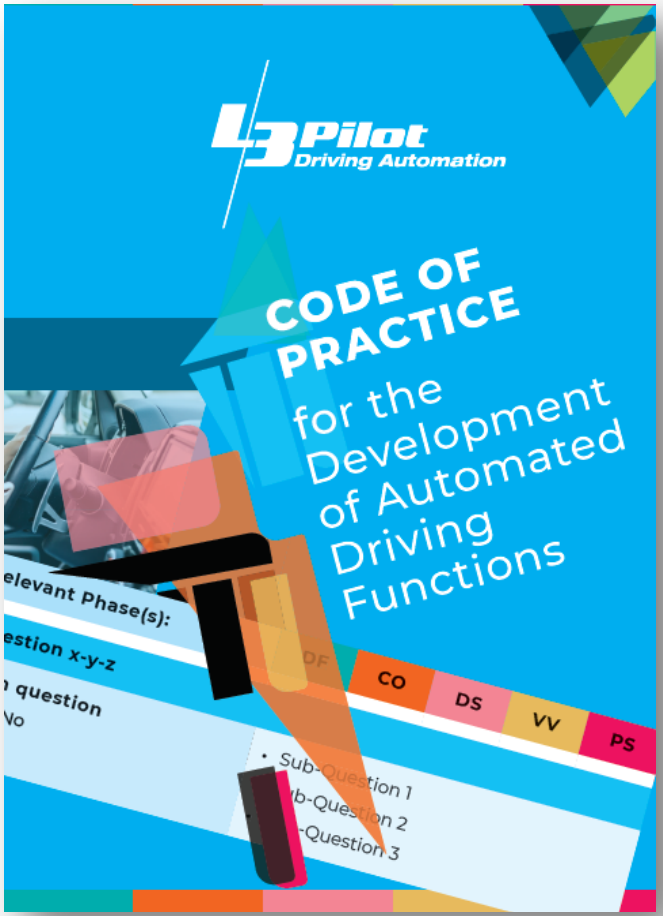
Code of Practice

CoP-ADF



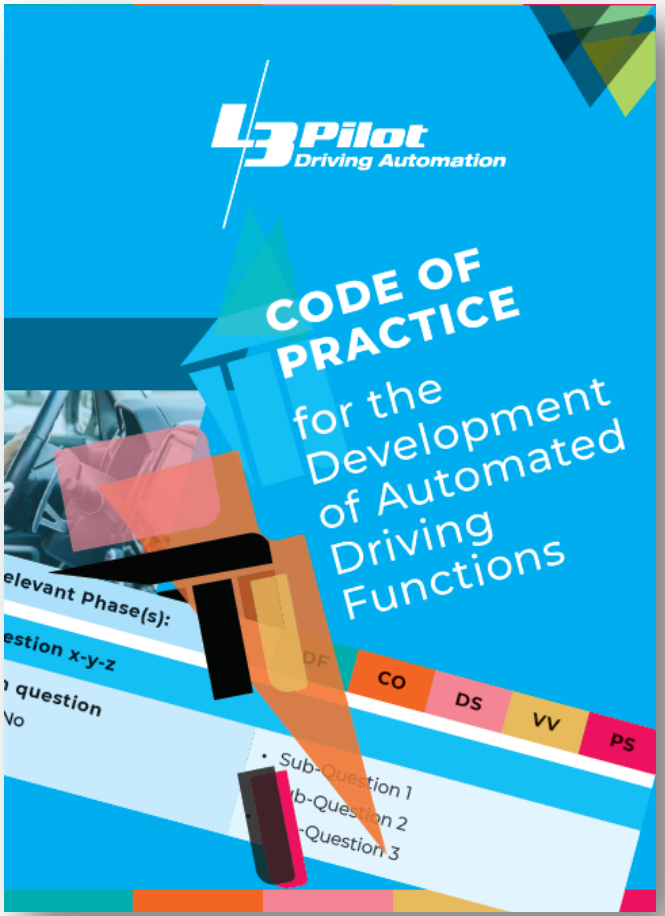
- Who is it for ?

Who is it for ?



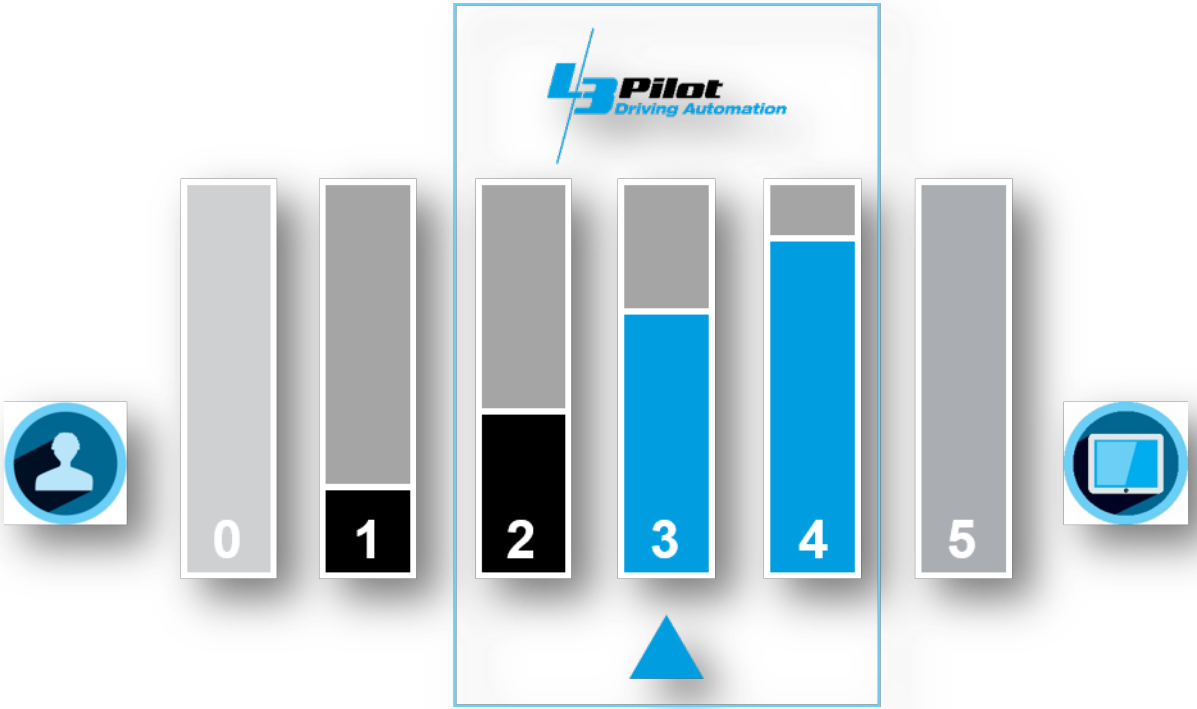
- Vehicle Manufacturers, Suppliers
- Insurance bodies
- Public Authorities
- Academics
- Regulation & Type approval bodies
- General Public

CoP-ADF



- Scope of CoP-ADF

Scope of the CoP-ADF



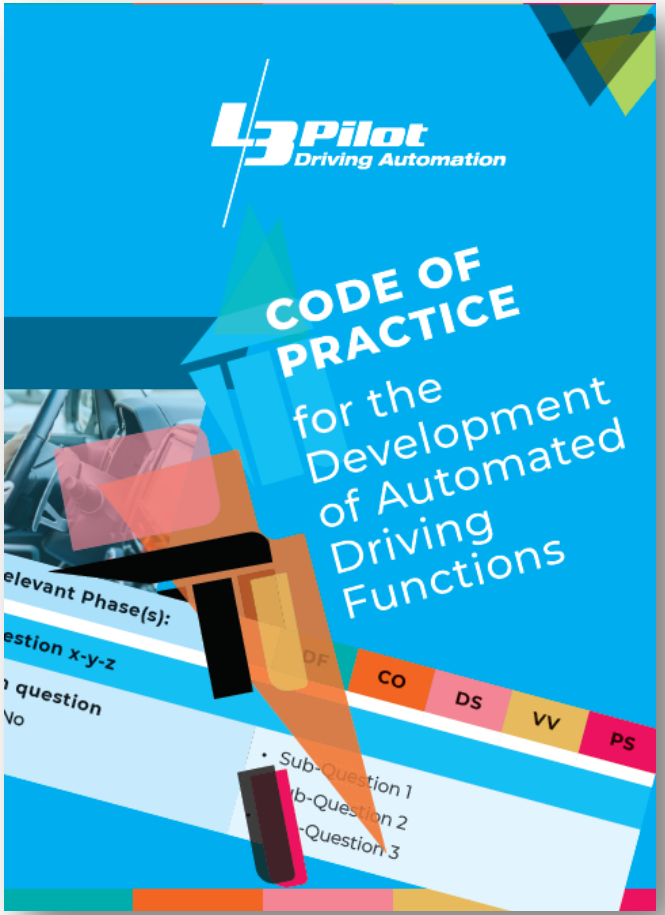
Motorway, Urban areas and Parking

ADF operating in non-EU regions

ADF operating at higher SAE levels (e.g. robot taxi)

.. And potentially

CoP-ADF



- What will you find in?

Contents

1. 5 categories
2. 22 Topics
3. 155 Questions (and even more sub-questions)
4. References to standards

Categories & Topics

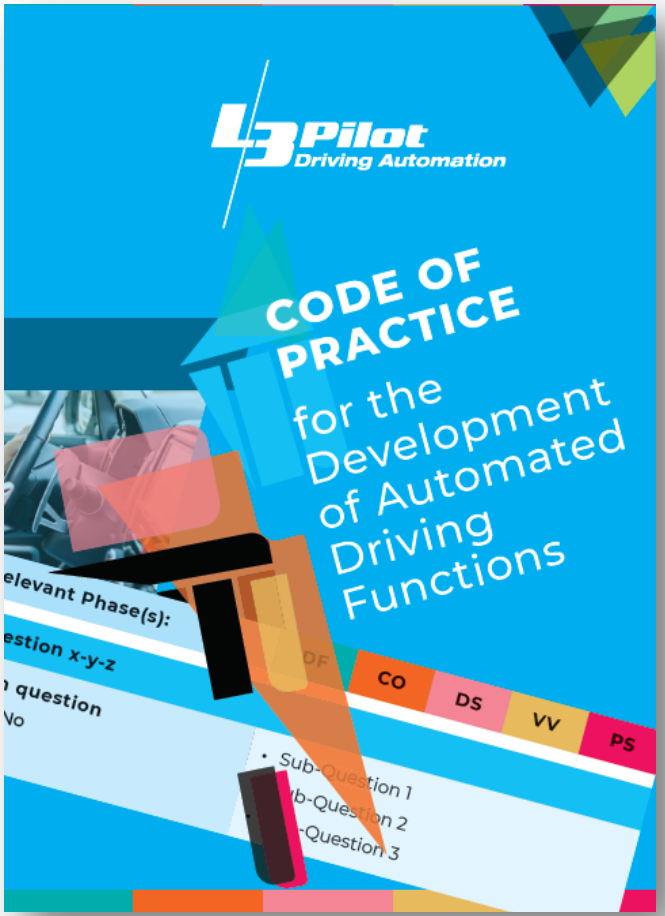
Category	Topics
Overall Guidelines & Recommendations	▪ Minimal Risk Manoeuvre ▪ Documentation ▪ Existing Standards ▪ Testing (including Simulation)
ODD Vehicle Level	▪ Requirements ▪ Scenarios and Limitations ▪ Performance Criteria and Customer Expectations ▪ Architecture
ODD Traffic System & Behavioural Design	▪ Automated Driving Risks and Coverage of Interaction with Mixed Traffic ▪ V2X Interaction ▪ Traffic Simulation ▪ Ethics & other Traffic related Aspects
Safeguarding Automation	▪ Functional Safety ▪ Cybersecurity ▪ Implementation of Updates ▪ Safety of the intended Functionality ▪ Data Recording, Privacy and Protection
Human-Vehicle Integration	▪ Guidelines for HVI ▪ Mode Awareness, Trust & Misuse ▪ Driver Monitoring ▪ Controllability & Customer Clinics ▪ Driver Training & Variability of Users

… All over the development process…

Structure of the questions

Relevant Phase(s):	DF	CO	DS	VV	PS
Question x-y-z					
Main question Yes / No	• Sub-Question 1 • Sub-Question 2 • Sub-Question 3				

CoP-ADF



- Examples

Category
Overall Guidelines & Recommendations
ODD Vehicle Level
ODD Traffic System & Behavioural Design
Safeguarding Automation
Human-Vehicle Integration

Relevant Phase(s):	DF	CO	DS	VV	PS

Question 0-2-2	Topic: Documentation
Is a documentation and reporting process in place with regard to assessing, testing and validating the ADF capabilities as well as design decisions? Yes / No	• Is a process established to document the performed tests and pass/fail compliance? • Is a process established to document updates of the test plan? • Does the documentation format comply with requirements of external stakeholders? • Is a safety argumentation (analogous safety case in ISO 26262) set up and described?

Category
Overall Guidelines & Recommendations
ODD Vehicle Level
ODD Traffic System & Behavioural Design
Safeguarding Automation
Human-Vehicle Integration

Relevant Phase(s):	VV
Question 1-3-5	Topic: Performance criteria and customer expectations
Is a process established to understand how customer expectations can be satisfied? Yes / No	• Does the process consider how customer expectations and capabilities change based on their driving experience in automated driving mode? • Does the process consider how customer expectations evolve based on their driving experience in manual driving?

L3Pilot Driving Automation

Code of Practice

Category
Overall Guidelines & Recommendations
ODD Vehicle Level
ODD Traffic System & Behavioural Design
Safeguarding Automation
Human-Vehicle Integration

Relevant Phase(s):	DF	CO	DS	VV	PS

Question 2-1-1	Topic: Automated driving risks and coverage interaction with mixed traffic
Are the risks of the ADF within its ODD considered? Yes / No	• Are the risks at entry to and exit from the ODD considered? • Are the risks from infrastructure or other road users considered? • Are unspecified or unexpected events identified from studies in real traffic? • Does the HARA consider unspecified or unexpected events? • Are the function limitations within the ODD considered? • Is the recording of ADF accident data or disengagements utilised to help identify risks? • Is there a mechanism for the publication or sharing of disengagements with a third party?

Category
Overall Guidelines & Recommendations
ODD Vehicle Level
ODD Traffic System & Behavioural Design
Safeguarding Automation
Human-Vehicle Integration

Relevant Phase(s):	CO	VV
Question 3-3-7	Topic: Implementation of updates	
Is a method implemented to notify the user and OEM of each successful update installation? Yes / No	• As part of the notification process is the user advised on the expected duration of the installation?	

Category
Overall Guidelines & Recommendations
ODD Vehicle Level
ODD Traffic System & Behavioural Design
Safeguarding Automation
Human-Vehicle Integration

Relevant Phase(s):	CO
Question 4-1-2	Topic: Guidelines for HVI
Are unintentional activations and deactivations of the ADF prevented? Yes / No	• Are the ADF controls designed so as to reduce accidental activation / deactivation? • Is the ADF able to determine accidental activations / deactivations vs intentional ones? • Is a fall-back considered for the case where an accidental deactivation occurs and the driver is not in the loop?

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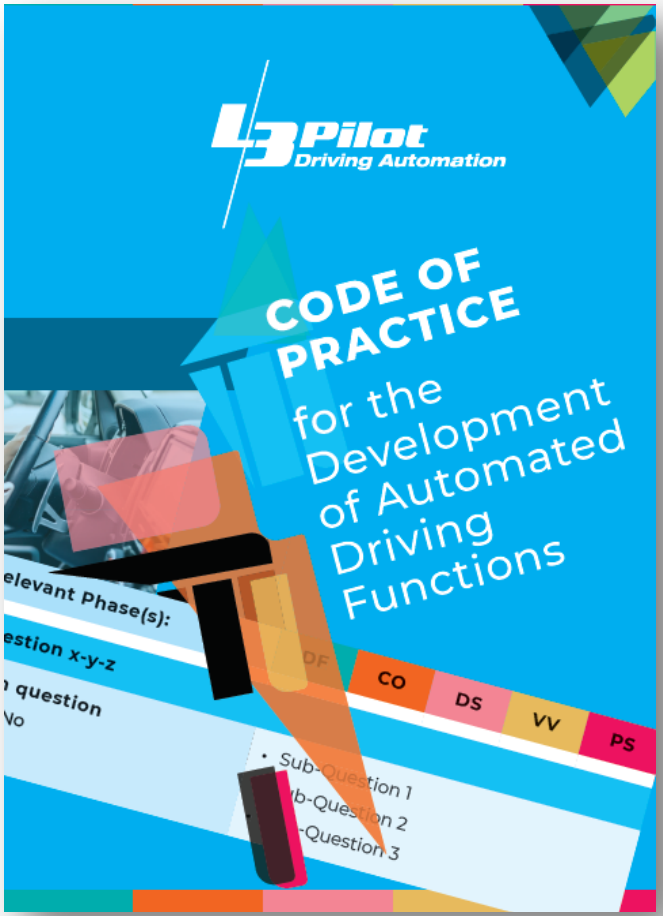
Code of Practice

CoP-ADF



- References

Main references

UNECE

L3Pilot Driving Automation

International Transport Forum

AdaptIVe Automated Driving

ISO

SAE INTERNATIONAL

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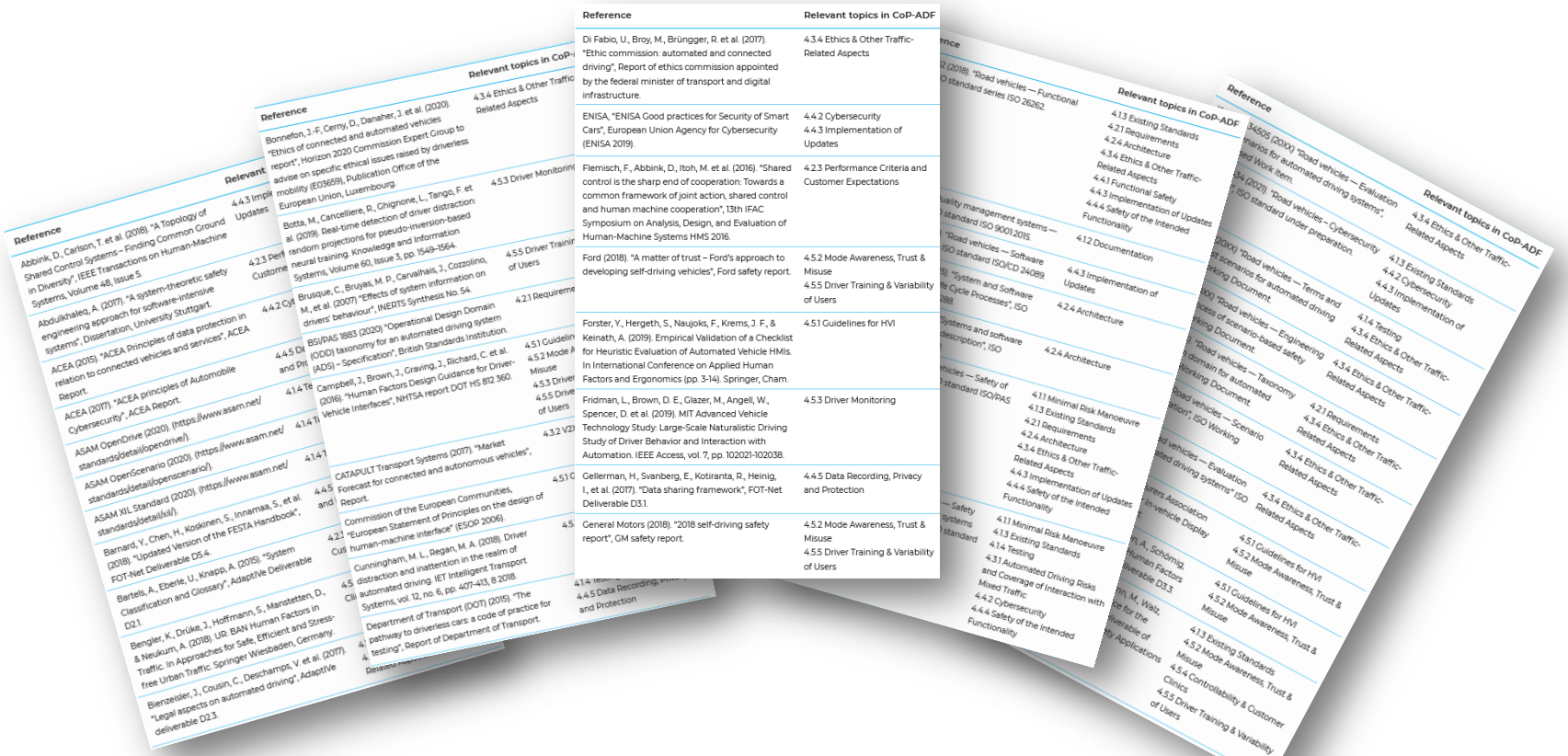
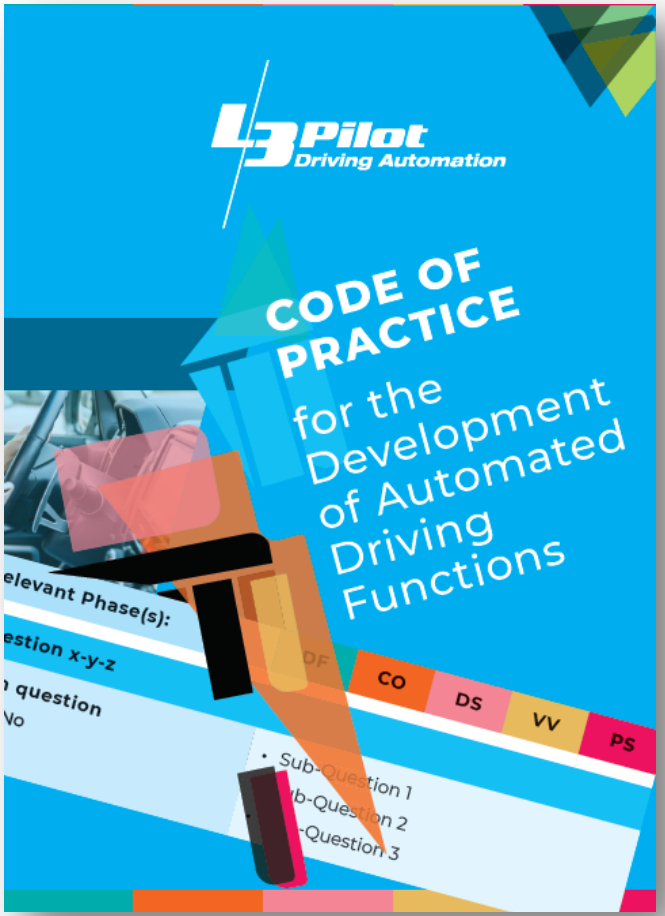
But also, many other ones



Reference	Relevant topics in CoP-ADF
Di Fabio, U., Broy, M., Brüngger, R. et al. (2017). "Ethic commission: automated and connected driving", Report of ethics commission appointed by the federal minister of transport and digital infrastructure.	4.3.4 Ethics & Other Traffic-Related Aspects
ENISA, "ENISA Good practices for Security of Smart Cars", European Union Agency for Cybersecurity (ENISA 2019).	4.4.2 Cybersecurity 4.4.3 Implementation of Updates
Flemisch, F., Abbink, D., Itoh, M. et al. (2016). "Shared control is the sharp end of cooperation: Towards a common framework of joint action, shared control and human machine cooperation", 13th IFAC Symposium on Analysis, Design, and Evaluation of Human-Machine Systems HMS 2016.	4.2.3 Performance Criteria and Customer Expectations
Ford (2018). "A matter of trust – Ford's approach to developing self-driving vehicles", Ford safety report.	4.5.2 Mode Awareness, Trust & Misuse 4.5.5 Driver Training & Variability of Users
Forster, Y., Hergeth, S., Naujoks, F., Krems, J. F., & Keinath, A. (2019). Empirical Validation of a Checklist for Heuristic Evaluation of Automated Vehicle HMIs. In International Conference on Applied Human Factors and Ergonomics (pp. 3-14). Springer, Cham.	4.5.1 Guidelines for HVI
Fridman, L., Brown, D. E., Glazer, M., Angell, W., Spencer, D. et al. (2019). MIT Advanced Vehicle Technology Study: Large-Scale Naturalistic Driving Study of Driver Behavior and Interaction with Automation. IEEE Access, vol. 7, pp. 102021-102038.	4.5.3 Driver Monitoring
Gellerman, H., Svanberg, E., Kotiranta, R., Heinig, I., et al. (2017). "Data sharing framework", FOT-Net Deliverable D3.1.	4.4.5 Data Recording, Privacy and Protection
General Motors (2018). "2018 self-driving safety report", GM safety report.	4.5.2 Mode Awareness, Trust & Misuse 4.5.5 Driver Training & Variability of Users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Driving Automation
CODE OF PRACTICE
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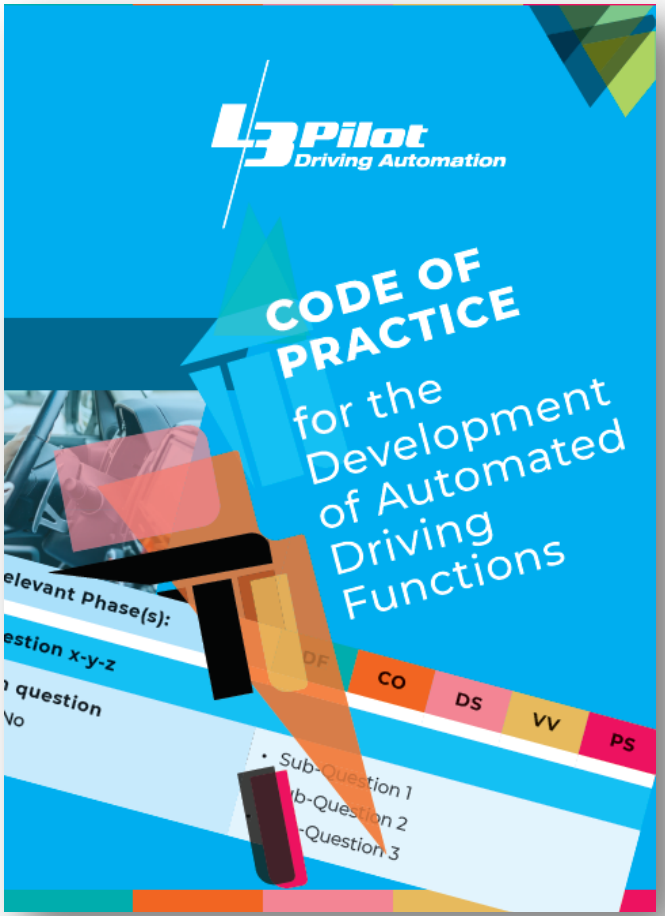
Sub-Question 1
b-Question 2
-Question 3

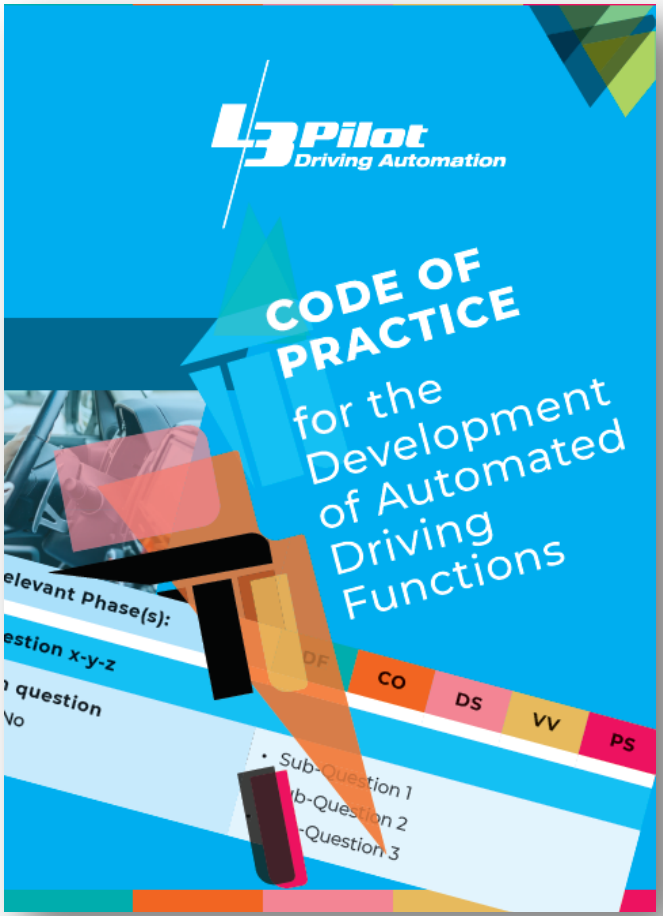
- Afterword

Afterword



- Scope of the CoP-ADF is not to provide technical solutions, but to support the development of ADF by ensuring that relevant aspects have been considered.
- The purpose of the questions is to make the developers and other relevant stakeholders aware of certain aspects and to ensure that reasons for decisions are taken and documented.

Last words



- No single approach for the implementation of safe ADF
- Neutrality in terms of technology
- This CoP-ADF presents a trade-off between detailed information and broad understanding
- Automated driving is a rapidly evolving technology: state-of-the-art needs to be continuously updated

L3Pilot Driving Automation

Code of Practice

Thank you for your kind attention.

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