Piloting Automated Driving on European Roads

L3Pilot paves the way
for large-scale field tests
of automated driving functions

L3Pilot
Driving Automation

SAE LEVEL 0 1 2 **3** 4 5

Aria Etemad, Volkswagen Group Innovation, L3Pilot Coordinator

"Automated driving technology has matured over the past ten years to a state in which road tests are required to answer key questions before the systems are introduced to the market. In the European research project L3Pilot, we are testing the viability of automated driving as a safe and efficient means of transportation. We will pave the way for large-scale field operational tests (FOTs) of automated in-vehicle functions."

In L3Pilot, we subject the functionality of automated driving systems to variable conditions in ten European countries, including cross-border routes. The technologies being tested cover a wide range of driving situations, such as parking, overtaking on motorways and driving through urban intersections. We cover the entire range of impact assessments, from the direct effects on driver behaviour to even the socio-economic impacts.

By the end of L3Pilot, we will have harmonised the various test sites as regards compliance with automated driving testing, thus creating a European-wide testing environment. To keep user desires in focus, we will collect data on user acceptance of vehicle automation in an annually published survey. Finally, involving various stakeholders we will explore the trends and commercialisation potentials related to the L3Pilot functions.

1,000 drivers

100 passenger cars

10 countries

Partner	Country	Region
Volkswagen	DE	Hamburg, Wolfsburg
Aptiv	DE, LU, FR	cross-border activities
AUDI	DE	Ingolstadt, Neckarsulm
BMW	DE	Munich
CRF	IT	Turin
FEV	DE	Aachen, Cologne
Ford	DE, BE, UK	cross-border activities
Honda	DE	Frankfurt am Main
ika	DE	Aachen
JLR	UK	Coventry
PSA	FR, DE	cross-border activities
Renault	FR	Paris and other regions
Toyota	BE	Brussels
Volvo Cars	SE	Gothenburg
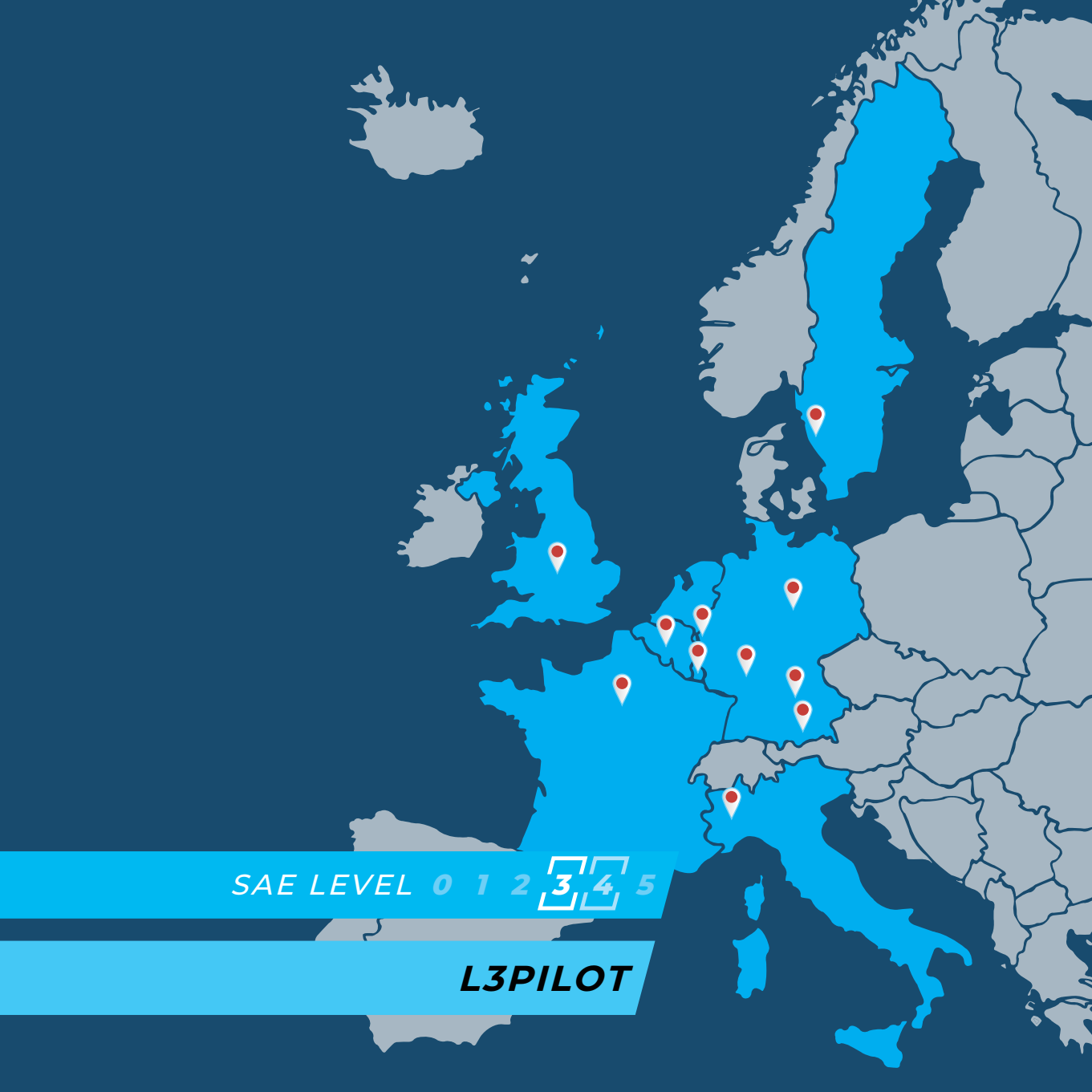
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L3PILOT

Facts

Research budget of €68 million,
€36 million of which has been
co-funded by the European Commission

Coordinated by Aria Etemad,
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Duration of 4 years
September 1, 2017 – August 31, 2021

Consortium includes 34 partners from
12 countries – Austria, Belgium, France,
Finland, Germany, Greece, Italy,
Netherlands, Norway, Sweden,
Switzerland, UK; including 13 OEMs,
3 suppliers, 12 research institutes and
universities, 2 insurers, 1 authority,
1 user group, and 2 SMEs.

**There will be a series of L3Pilot
showcases throughout the
project`s duration. Learn more
and follow us on Twitter,
LinkedIn and on our website.**

Twitter @_L3Pilot_
LinkedIn L3Pilot
www.L3Pilot.eu

EVALUATE

Code of Practice

Evaluation

DRIVE

Piloting

Data

DEPLOY

PREPARE

Fleet

Create European-wide
Piloting Environment

Provide User Studies

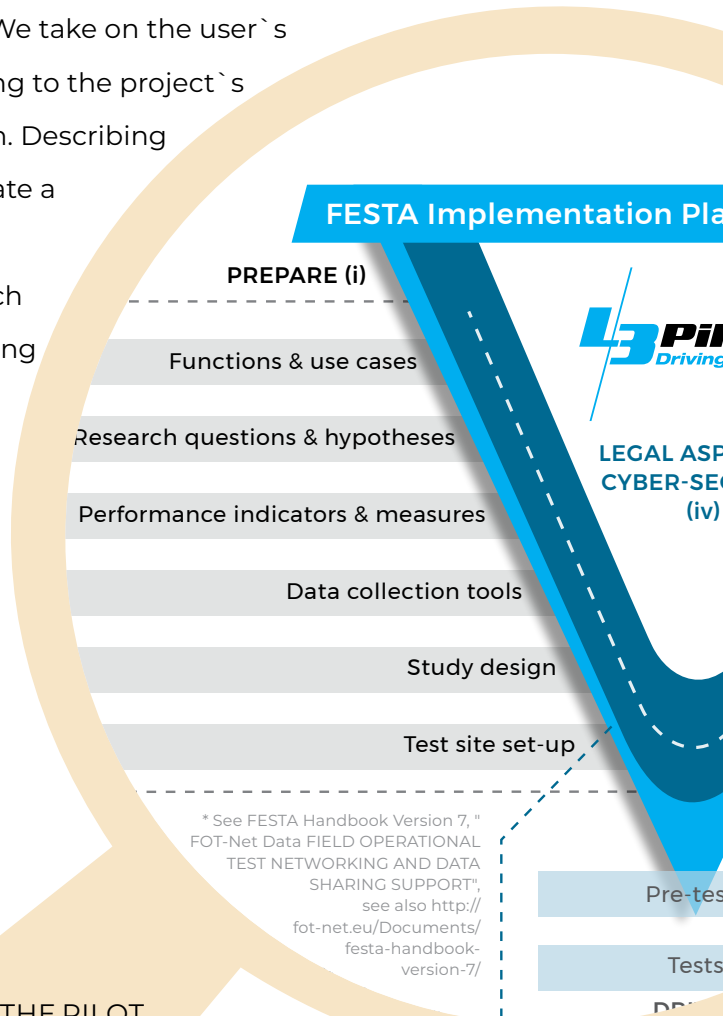Conduct Business Studies
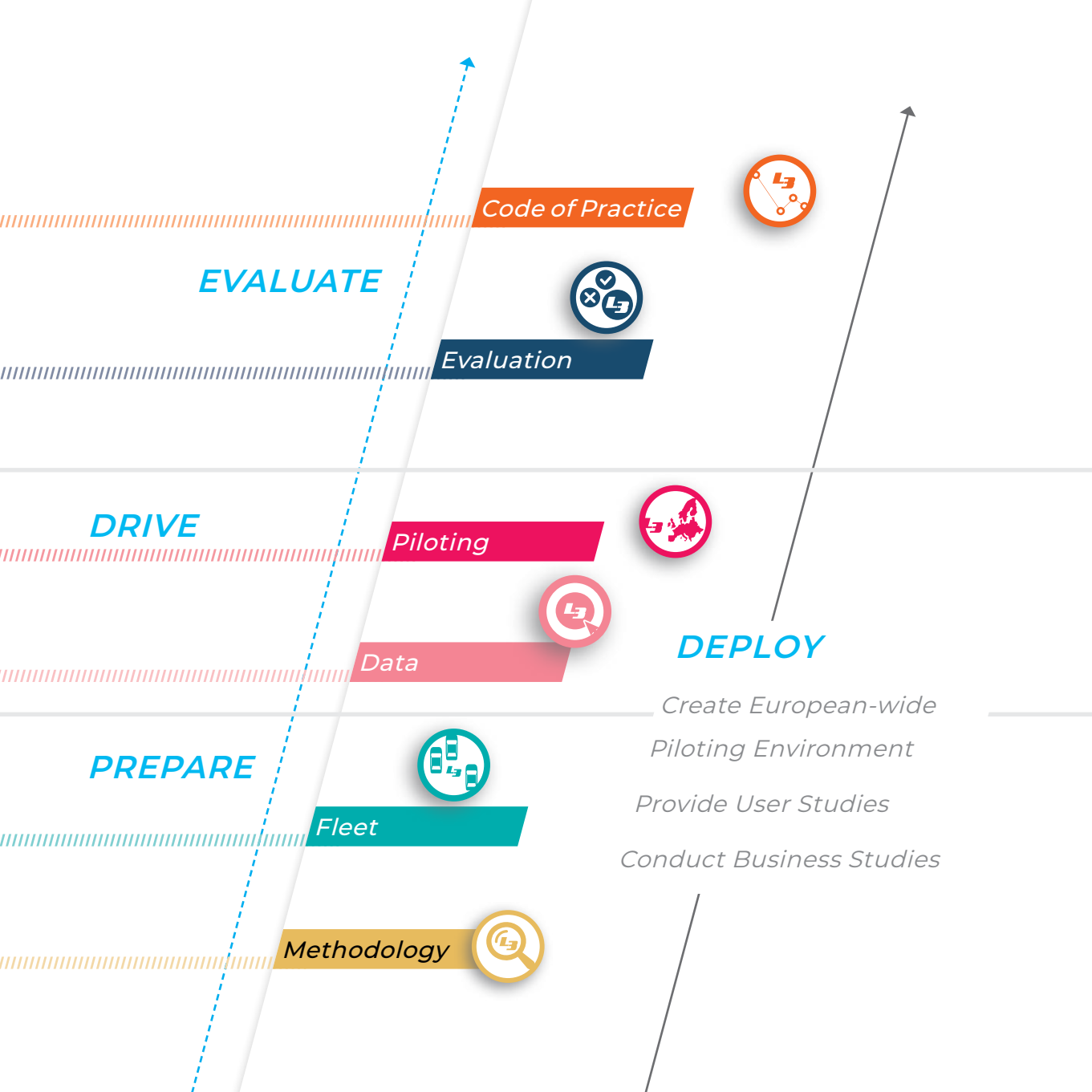
Methodology

Providing a Comprehensive Methodology

Before beginning testing, we will set up a comprehensive methodology for piloting, evaluating and testing automated in-vehicle functions. We take on the user`s point of view according to the project`s user-centric approach. Describing the functions, we create a solid foundation for setting up the research hypotheses and logging requirements as well as for developing the experimental procedures. For the overall methodology we refer to FESTA* and have modified it to better match the project`s objectives.

* See FESTA Handbook Version 7, " FOT-Net Data FIELD OPERATIONAL TEST NETWORKING AND DATA SHARING SUPPORT", see also http:// fot-net.eu/Documents/ festa-handbook-version-7/

FESTA Implementation Pla

PREPARE (i)

Functions & use cases

Research questions & hypotheses

Performance indicators & measures

Data collection tools

Study design

Test site set-up

**LEGAL ASP
CYBER-SEC
(iv)**

Pre-tes

Tests

PHASE I PREPARING THE PILOT

Preparing the Cars for the Pilot

Another task in the run-up to the testing is to provide a taxonomy and description of the fleet`s automated driving functions to be evaluated. We adapt, implement and pre-test the functions in the pilot fleet vehicles. In doing so we also consider legal issues such as compliance with laws and regulations, including data privacy and insurance.

Securing Automated Driving

Automated driving needs to be protected against multiple attack vectors such as hacking, tampering and misuse of the system, both inside vehicles as well as in remote parts of the car ecosystem. We assess a wide variety of cyberattacks in a controlled simulation environment.

L3PILOT APPLICATIONS

| TRAFFIC JAM	MOTORWAY	PARKING	URBAN AREA
TRAFFIC JAM CHAUFFEUR	MOTORWAY CHAUFFEUR	PARKING CHAUFFEUR	URBAN CHAUFFEUR
	MOTORWAY PILOT	PARKING PILOT	
SAE LEVEL 0 1 2 3 4 5	SAE LEVEL 0 1 2 3 4 5	SAE LEVEL 0 1 2 3 4 5	SAE LEVEL 0 1 2 3 4 5

Developing Data Management Tools

All data-related activities will be supported by a set of tools that we develop for the pilot purposes. We define data logger requirements and provide the appropriate data loggers. Working together we develop data formats for analysing and describing L3Pilot data, work on the correct strategy for data storage, and flesh out the needed data processing tools. The guidelines and lessons learned about data logging, storage and management will be made available after the project.

Expected Data Flow
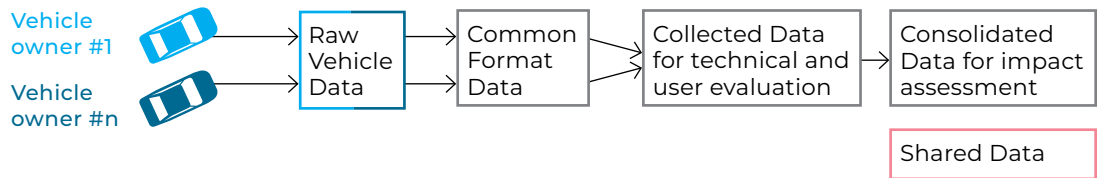
Data Categories

We distinguish between four categories of data produced in L3Pilot research: 1 derived vehicle data from controller area network, GPS, sensors, performance indicators and video annotations; 2 subjective data from interviews, questionnaires and simulator studies; 3 external data such as weather, map and; 4 shared data.

Carrying out Pilot Tests

We coordinate and harmonise our testing activities to meet the challenges of executing a pilot across ten European countries, including cross-border activities. The testing is monitored: we ensure that data delivery is properly handled by data owners, by the project and as regards data verification rules that have been agreed upon.
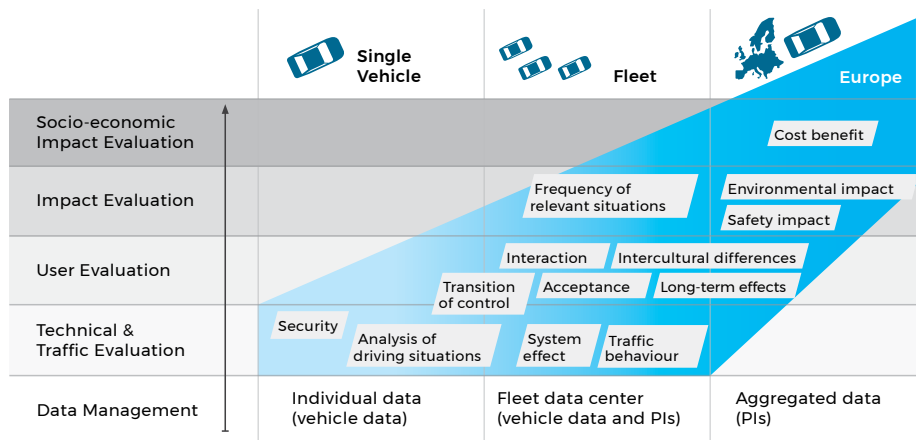
Regional Test Clusters

North

Central

South-West
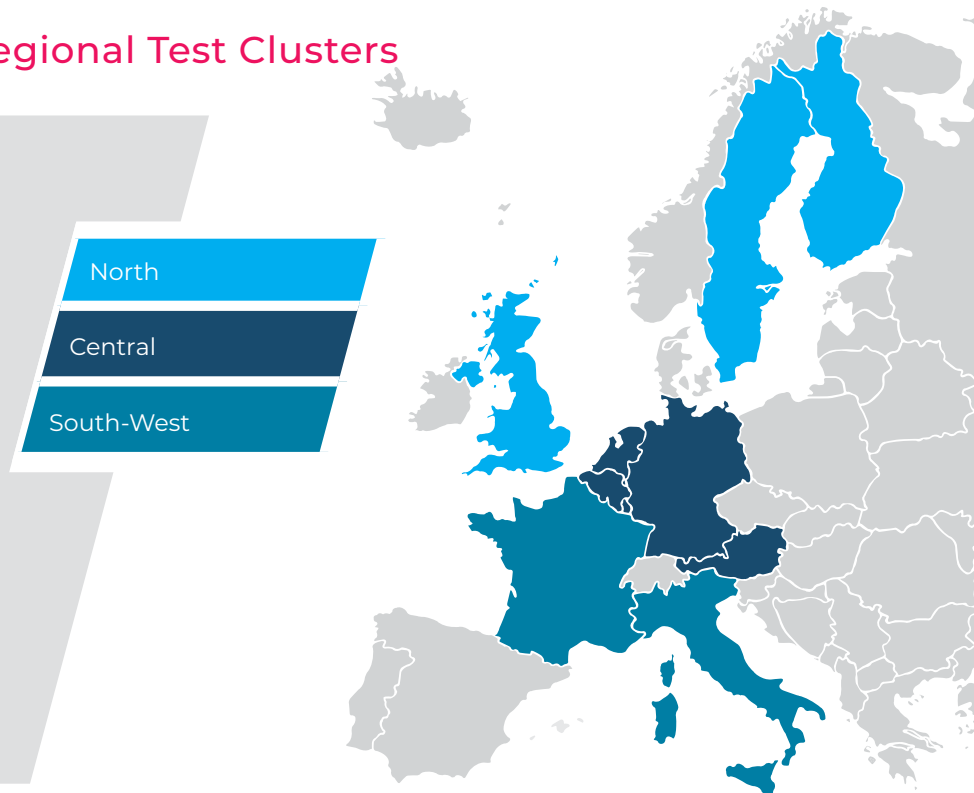
Evaluating Results

After having collected the pilot data, we will analyse it and draw conclusions on technical aspects, user acceptance, driving and travel behaviour, and the impact on traffic and safety. We assess long-term effects of automated driving on user –attitudes and acceptance as well as the readiness and reliability of automated driving functions. We determine the safety, efficiency, mobility and economic impact of automated driving applications under mixed automated traffic conditions based on real-world pilot data and further develop simulation tools. Furthermore, we will provide a cost-benefit analysis with respect to Europe as a whole.
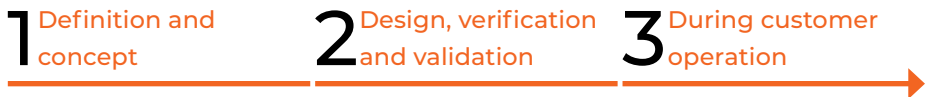
	Single Vehicle	Fleet	Europe
Socio-economic Impact Evaluation			Cost benefit
Impact Evaluation		Frequency of relevant situations	Environmental impact / Safety impact
User Evaluation		Transition of control / Interaction / Acceptance	Intercultural differences / Long-term effects
Technical & Traffic Evaluation	Security / Analysis of driving situations	System effect / Traffic behaviour	
Data Management	Individual data (vehicle data)	Fleet data center (vehicle data and PIs)	Aggregated data (PIs)

Providing a Code of Practice
for Automated Driving

We will collect best practices on developing automated driving functions and compile them into a Code of Practice. In this, we will describe a typical process for developing automated driving functions, including hands-on checklists and safety aspects as well as methods to confirm the safe operation of automated driving functions.

Best practices will be provided for three development phases of automated driving functions:

1 Definition and concept   2 Design, verification and validation   3 During customer operation

L3PILOT APPLICATION
TRAFFIC JAM CHAUFFEUR

10 HOURS A WEEK

Again, stuck in a traffic jam, like every day.

I AM SO TIRED OF IT.

The L3Pilot Traffic Jam Chauffeur relieves you from exhausting, manual driving during traffic jams.

RELAX AND USE INFOTAINMENT FUNCTIONALITIES

On motorways and similar roads the car takes over the driving in traffic jam up to 60 km/h. When the detection of slow driving vehicles in front indicates a traffic jam, the function can be activated. In some instances, the car changes the lane to react to a slower vehicle ahead or infrastructural reasons like exit lanes.

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TRAFFIC JAM CHAUFFEUR

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L3PILOT APPLICATION
MOTORWAY CHAUFFEUR
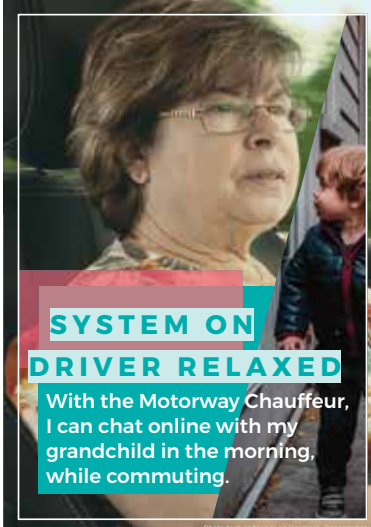
COMMUTING FOR 27 YEARS

SAME BORING MOTORWAY EVERY DAY

SYSTEM ON DRIVER RELAXED

With the Motorway Chauffeur, I can chat online with my grandchild in the morning, while commuting.

With the Motorway Chauffeur the car adapts to various traffic conditions. It follows the lane and adjusts speed considering various factors such as keeping a safe distance to the vehicle in front or following the speed limit. If a preceding slower vehicle is detected the car overtakes automatically as soon as it is safely possible.

MOTORWAY CHAUFFEUR

SAE LEVEL 0 1 2 **3** 4 5

L3PILOT APPLICATION

PARKING CHAUFFEUR

5 MINUTES ARE A LOT IN THE MORNING

WOULDN'T IT BE NICE TO HAVE YOUR CAR WAITING OUTSIDE FOR YOU?

Photo by Flo Ruppert on Unsplash

LUCKILY I HAVE MY PARKING BUDDY.

Welcome to the L3Pilot home zone parking.

Depositphotos

The Parking Chauffeur allows the user to request their vehicle to complete manoeuvring into and out of garages and driveways. The car learns a fixed trajectory from the entrance of the house to the home garage and vice versa. This automated driving feature relieves the driver from repeating parking manoeuvres.

Photo by ... on Unsplash

L3Pilot
Driving Automation

PARKING CHAUFFEUR

SAE LEVEL   0   1   2   **3**   4   5

L3PILOT APPLICATION

URBAN CHAUFFEUR

Didn't want to miss my morning yoga.

WILL I MAKE IT RELAXED TO WORK, WITH THIS DENSE TRAFFIC?

Photos by Roman Koester, Serhat Beyazkaya on Unsplash

STRESS-FREE DRIVING IN URBAN AREAS.

With the L3Pilot Urban Chauffeur I don't worry anymore about rush hours.

Pixnio.com/fr

With the Urban Chauffeur the vehicle automatically follows the lane, starts and stops and handles overtaking within cities. When coming to a crossing the car handles right and left turn, recognises on-coming traffic and vulnerable road users such as pedestrians, and selects the correct crossing path, even if no lane marking is present.

L3Pilot
Driving Automation

URBAN CHAUFFEUR

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Partners

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EUROPEAN COUNCIL FOR AUTOMOTIVE R&D