# The Autonomous Vehicle Global Study

The most thorough analysis of driverless vehicles ever published

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# The consulting & research firm for the connected world

### **Consulting services**



#### **Research services**



### **Fields of expertise**

Mobility services	Car pooling Car sharing Smart parking	Multimodal mobility Ride hailing	Road side assistance Tax refund
Vehicle services & telematics	bCall eCall FMS SVT / SVR	Tracking VRM In-car Wi-Fi Fuel cards	Parking Navigation Speed cameras Traffic information
Usage-based charging	Car As A Service Electronic Toll Collection	Mobility-as-a- Service Road charging	UBI / PAYD Vehicle rental Vehicle leasing
Vehicle data & analytics	AI CAN-bus Crowd-sourcing Data protection	Driving behaviour OBD Predictive analytics	Remote diagnostics xFCD
Vehicle data & analytics Vehicle automation	AI CAN-bus Crowd-sourcing Data protection ADAS	Driving behaviour OBD Predictive analytics Autonomous cars	Remote diagnostics xFCD Autonomous trucks

# Clients across the mobility ecosystem...





# Autonomy will reshape the automotive industry...



Mary Barra CEO



auto industry will change more in the next 5 to 10 vears than it has in the last 50."

"I believe the



than a particular vehicle, ... What we are bringing to market is a selfdriving technology platform."



CEO



Harald Krueger, CEO







"Non autonomous cars will be like owning a horse: for sentimental reasons"

Elon Musk

CEO

TESLA



### ... It will also completely transform the mobility ecosystem

#### • Autonomy is a technology revolution...

- More sensors, software code and processing power than ever
- Faster connectivity and more accurate positioning than ever
- More (artificial) intelligence than ever
- ... but it could also be a tornado wiping out the ecosystem:
  - **OEMs** being reduced to hardware providers for Silicon Valley?
  - Tier-1 suppliers losing out to electronic players such as Samsung and Intel?
  - Dealers and workshops losing much of the repair business?
  - Insurers, brokers and reinsurers losing on claims and premiums?
  - Roadside assistance companies and auto clubs made redundant?
  - **Public transport operators** and **the taxi industry** becoming useless as a result of automated Mobility-as-a-Service (MaaS)?
  - Telematics Service Providers (TSPs) becoming dis-intermediated?
  - Car rental and leasing operators losing independence from OEMs?
  - Road operators and toll chargers being forced to move to free flow tolling?

In the long term, the generalisation of autonomous vehicle means that 80 to 90% of the motor insurance business could disappear, along with claims management.



Pascal Demurger General Director MAIF Insurance



### PTOLEMUS



### The AV Global Study responds to all major questions





### No less than 10 experts conducted our research and analysis

#### Frederic Bruneteau, Managing Director, Brussels



Mr. Bruneteau has accumulated 20 years of experience including 17 years of experience of the mobility domain and 8 years of strategic and financial advisory for company such as Arthur D. Little, BNP Paribas, SFR Vodafone and TomTom.

He has become **one of the world's foremost experts in the field of telematics**, quoted by numerous publications such as *The Economist* and *the Financial Times*. He has spoken at more than 40 international conferences on the subject.

Within PTOLEMUS, he has **led 70** assignments related to connected **&** autonomous vehicles for leaders such as Aioi Nissay Dowa, Allianz, AXA, Bridgestone, CNES, Generali, HERE, Kapsch, Liberty Mutual, Michelin, Octo Telematics, Pioneer, Qualcomm, Telit, Thales Alenia Space and Toyota.

Frederic performed a complete review of this report.

#### Matthieu Noël, Manager, Paris



An automotive engineer, Matthieu Noël has gained 6 years of consulting experience in the automotive sector primarily helping car manufacturers such as BMW, PSA Peugeot-Citroën, Renault-Nissan and Faurecia.

Within PTOLEMUS, he has advised numerous clients such as Admiral, Airbiquity, Allianz, Bridgestone, HERE, Kapsch, Michelin, Octo Telematics or Vodafone Automotive in defining and implementing their strategy.

He holds expert knowledge of domains such as connected vehicle data & analytics, OBD dongles, vehicle repair and maintenance, fleet telematics, fuel card services, ETC, UBI, autonomous vehicles, etc.

Matthieu performed a complete review of this report.

#### **Thomas Hallauer, Research Director, London**



Thomas Hallauer has gained 15 years of strategy, research and marketing experience in the domain of telematics and locationbased services from companies such as Admiral, DriveFactor, Liberty Mutual, Michelin, Mobile Devices, Octo Telematics and Wunelli.

Thomas is the lead author of the ETC Global Study, the most thorough review of the Electronic Toll Collection and Road Charging market published in May 2015.

Thomas also published the UBI Global Study 2016 and reviewed the Connected Insurance Analytics Report, interviewing dozens of insurance companies.

Thomas led the research, writing and publishing of this report.

#### Justin Hamilton, Senior Business Analyst, London



Justin has more than 4 years of experience within the transportation, mobility and road user charging market. He conducts quantitative and qualitative analysis of global trends and developments in mobility, electronic road pricing and intelligent transport solutions.

Before joining PTOLEMUS, Justin launched Road User Charging Magazine and is frequently published in journals such as *Thinking Highways*, *Tolling Review* and *Tolltrans*.

For this report, Justin explored the relationship between autonomous cars and mobility and evaluated the factors driving the timeline of autonomy.

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### No less than 10 experts conducted our research and analysis

#### Alberto Lodieu Senior Consultant, Paris



Alberto has gained 7 years of experience in strategic and operations consulting, helping organisations such as CNES, Danlaw, Europ Assistance, the European Commission and Liberty Mutual.

Alberto has participated in more than 20 projects to help organisations identify, define and implement the initiatives needed to achieve or preserve their leadership position.

Alberto recently helped a client understand the impact of AVs for the space industry.

For this report, Alberto analysed the **evolution of** the relationship between drivers and cars and the acceptance of AVs by customers.

#### Philippe Brousse Senior Business Analyst, Brussels



Philippe has gained 3 years of experience in strategy and market research for companies such as Danlaw, Europ Assistance, the European Commission, Kapsch, Liberty Mutual, Octo Telematics and Safran Morpho.

For our Connected Mobility Forecast, he conducted the analysis and 5-year forecasts of the markets for bCall, UBI, fleet management, and in-vehicle WiFi hotspots worldwide.

Philippe recently helped a client detect possible satellite communications technologies for AVs.

For this report, **Philippe contributed to the building of our bottom-up market forecasts of the ADAS and AV markets globally.** 

#### Claire Elnécavé Senior Expert, Brussels

Claire has gained 12 years of experience for companies such as Accor, Arthur Andersen, Baloise Insurance, Baupost Group, Carrefour, CIC Securities, Coyote System, Pioneer, Sara Lee and Solvay.

She is expert at auditing and developing business models, financial statements, business plans, financial models and market models.

She is also **leading the creation of the Autonomous Club**, a think tank focused on industry and regulatory evolutions driven by the emergence of autonomous vehicles.

For this report, Claire contributed to our analysis of major AV technology suppliers.

#### Yaron Steinfeld Business Analyst, Paris



Yaron has gained experience in strategy and market research for organisations such as **Cleia, CNES, HERE, LafargeHolcim and Octo Telematics**.

Yaron has worked on several connected mobility projects related to vehicle data, UBI, roadside assistance, car pooling.

For one of our clients, Yaron recently analysed possible positioning technologies to locate AVs.

For this report, Yaron led our analysis of the impact of ADAS and AV technologies on the number of accidents and their severity.

#### Sahand Malek Consultant, Brussels



A PhD in Automotive Engineering, Sahand has gained almost 5 years of experience in automotive research and development projects on vehicle On-Board Diagnostics (OBD), data management and analytics and Advanced Driving Assistance Systems (ADAS).

He has in-depth knowledge about many aspects of traffic and transportation science, as well as automotive engineering.

Sahand led the writing of our recently published Connected Insurance Analytics Report.

For this report, Sahand built our bottom-up market forecasts and scenarios of the ADAS and AV markets globally.

#### Matthew Cobbold Business Analyst, London



Matthew has gained 2 years of strategy and research experience for companies such Strategy& (PWC group), Ernst & Young and WS Atkins.

Matthew has **performed several research and market modelling projects** for construction, pharmaceutical and telecommunication industries.

He recently participated to the commercial due diligence of a cyber security solution provider. Matthew led researches and interviewed experts to size the hardware security modules market.

For this report, Matthew contributed to **modelling** the impact of AVs on insurance claims and premiums and analysing the technology suppliers.



# This report builds on 18 months of analysis of technology, supply & demand and the regulatory environment

#### **BUILDING BLOCKS**

- Country-by-country regulatory analysis
- Country-by-country market readiness analysis
- Global safety rating landscape analysis
- Value chain definition
- Map of M&A and partnerships
- 60 interviews of the key players
- 2000 hours of desk research and analysis
- 3 adoption scenarios
- ADAS impact on claims model
- ADAS impact on premium components model
- ADAS impact on driving score model
- ADAS features supply database
- Customer ROI per level
- Timeline of launch by country by level
- Strategic analysis of 14 car manufacturers
- ADAS features examination
- Technical building block analysis
- Technology cost model
- Global supplier database

#### **KEY OUTPUTS**

- 1. Assessment of core technologies required for automation
- 2. Timeline of the key market triggers from 2015 to 2030
- 3. Route-to-market analysis
- 4. Analysis of the key trends
- 5. AV adoption scenarios by level
- 6. AV market forecasts by level
- 7. Accident reduction forecast
- 8. Impact of automation on the automotive market
- 9. Claims reduction forecast
- 10. Insurance premium forecast by level

#### Environment

#### Methodology

#### Supply & demand

#### Technology

### PTOLEMUS Source: PTOLEMUS

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	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 4 DRIVERLESS	LEVEL 5
Example	Ford Focus 2016	Tesla Model 3	Mercedes E Class	Navya Arma shuttle	Rolls-Royce Vision Next 100
Launch date	2010	2017	2021	2021	2030?
Enabling technologies	Sensors (Camera, radar)	3D / HD maps	Lidar, V2V, V2I	Lidar, V2V, V2I	Full AI HA GNSS
Defining application	ADAS	Advanced Cruise Control	Autonomous car	Driverless car	Driverless car
Regulation change required	Type approval	Highway code	UNECE R79	City mandate	International transport laws
Driver responsibility	Full liability	Full liability	Partial liability	No liability	No liability



# Many challenges still need to be resolved

The 12 gates to automation

- Technology requirements
   Driver re-engagement
- Traffic regulations
   · Car data sharing
- Pre-market approval

- Al driver's risk profile
- Remote vehicle update
- Insurance regulations
- Market entry strategies
- Liability definition
- Customer acceptance
- Security against attacks



# AV's tangible benefits to drivers will be really felt at level 4



### PTÓLEMUS

Source: PTOLEMUS. - Note: \* Average value of ADAS / automation across all vehicle segments



# Passenger car sales with ADAS will top 45 million by 2020



**PTÓLEMUS** 

#### **Rationale and comments**

- Most new cars after 2018 are expected to have AEB (Automatic Emergency Braking)
- We expect L2 to represent 62% of new car registrations in 2030
- By 2030, **HAVs (L4) will represent 8%** of new car sales, adding up to more than 5.5 million units
- Overall, while **China** is the largest market for L1 and L2 cars, the **USA** will still lead for L3 and L4 cars
- The US, UK and Germany are expected to be the earliest market for L4

#### Source: PTOLEMUS autonomous vehicle market forecasts



# In Europe, ADAS and AV's penetration will reach 37% by 2030



**PTÓLEMUS** 

#### Rationale and comments

- By 2024, we expect the number of level 2 passenger cars in Europe to exceed vehicles with driver assistance features
- Level 2 cars will reach the 10% mark by 2023 and 20% by 2028
- From 2018 to 2020, L3 cars will be introduced in most EU countries, starting with the executive segments
- Progressively, new cars sold in the upper and lower medium segments will become "L3": sold with advanced cruise control
- Level 4 and driverless penetration will grow rapidly but **remain under 5%**, even in 2030



#### Level 2-5 passenger cars on the road in 2030 (million)





# The automotive industry is reshaping as we speak





# Nobody will be left untouched





# And for insurers, the sea is not getting any quieter...





# The study quantifies the true impacts of ADAS and AVs on safety, risks and the complete ecosystem



The most thorough investigation of the driverless future

- 600+ pages of research using:
  - 60 interviews in 8 countries
  - 12 months of research performed by 10 consultants
  - A uniquely precise and complete methodology
  - over 200 figures (charts, tables, etc.)
- Assessment of the key factors affecting the start, the acceleration speed and the penetration of the different level of automation from today to 2030
  - Overview of the regulatory background, applicable regulation, evolution and trends globally
  - Complete analysis of the technology building blocks including suppliers and cost analysis
  - A global quantitative analysis of the mobility market and its role in delivering driverless cars

- 27 ADAS explained and their impact on claims analysed
- 21 OEMs and technology providers analysed and their AV strategy compared
- A qualitative & quantitative evaluation of the impacts of automation on
  - Safety
  - Personal data protection
  - Connected services
  - The automotive industry
  - The risk sector
- 2015-2030 bottom-up ADAS & AV market forecasts
  - Global forecast over 18 markets
  - ADAS and AV penetration forecast by level and car segment
  - Forecast on crash volumes and severity, claims costs and insurance premiums

### PTOLEMUS



# 250 companies mentioned in the report

					Company		Туре	Comp	sany Typ	90						
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Alpine	BAE Systems	Automotive hardware supplier	NASA	Sottware/Al developer	CTAG	institut	Ertico	F	Research/standards	Savari	Grab	Provider Mobility S	ervices	Times car Pro	* Pi	ovider
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### **Over 600 pages: simply the deepest report on the subject**



#### SECTION I: THE KEY BENEFITS AND CHALLENGES OF ADVANCED DRIVING ASSISTANCE SYSTEMS (ADAS)

#### 1. What are ADAS and autonomous functions

- A. The 4 human cognitive processes
- B. The 4 steps of ADAS evolution
- C. The 6 major systems group
- D. The 5 levels of automation [... or is it 47]

#### E. Today's OEM involvement 2. What is at stake here?

- A. Analysis of the impacts of automation B. 10 other markets that will be affected by ADAS
- C. Alongside the evolution of ADAS, EV will emerge

#### 3. The key technologies involved and their evolution

- A. Passive to active to ADAS safety systems
- B. Upfitted and embedded safety systems
- C. The building blocs of ADAS
- D. The 12 gates left to cross before cars are automated

#### SECTION II: LEARNINGS FROM THE RESEARCH AND TRIALS

#### 1. The public-funded European projects

- 2. The biggest spenders in R&D budgets
- 3. The first steps in commercial vehicle automation

### REPORT

SECTION III: HOW AUTONOMY IS CHANGING

A. Measuring and anticipating customer resistance/ acceptance

B. How autonomous vehicle will manage re-engagement in the future

C. Analysis of the emerging challenges in re-engagement process

D. Assessment of the OEM-Driver communication and the required

2. The transition to autonomous driving from the customer

A. The new challenges of buying, selling, and using ADAS

D. The business case for the level 4 driverless scenario

4. Assessment of the core manufacturers' and suppliers'

3. What can we learn from the Tesla crashes

strategies and the evolving landscape

E. The role of technology suppliers in automation

1. The evolution of the car- driver relationship

THE CAR INDUSTRY

changes

perspective

E. ADAS data management strategy

**B.** Segmenting the ADAS technologies

C. The business case for the customer

A. Analysis of the 4 cases

B. The imminent future for OEMS

F. Comparing the core suppliers

C. How the OEMs compare

B. Tesla's response

C. Tesla's liability

A. OEM profiles

D. Supplier Profiles

#### **STRUCTURE** 8. Modelling the impact of ADAS and autonomy on claims reduction

C. ADAS impact on claims reduction D. Calculating the impact of ADAS on accident reduction

SECTION IV: CALCULATING THE IMPACT OF

1. ADAS testing and market penetration evolution

B. The role of NCAPs in the deployment of ADAS safety technologies

C. Quantifying the adoption of ADAS in 3 mature, developed markets

ADAS ON INSURANCE COSTS/ REVENUES

A. Safety testing stakeholder landscape

reduction

E. Next steps to better calculate claims and premium reduction

2. How to calculate the impact on claim and premium

A. The challenge behind calculating the impact of ADAS

#### F. How to calculate the impact of ADAS on Premium Expenditure

#### 3. Impact of autonomous functions on the UBI proposition

- A. Calculating the impact of ADAS features on driver behaviour and UBI scores
- 8. Will autonomy signal the end of UBI?

#### SECTION V: THE ENVIRONMENTAL FACTORS INFLUENCING THE TIMELINE

- 1. The current regulations and how they impact the evolution of ADAS and automation
- A the Vienna Convention
- 8. Regulations for experimenting on autonomous functions
- C. Traffic Rules (national and international conventions
- **D.** Technical Vehicle Regulations
- E. Civil and criminal law do they apply as is or are changes needed? F. How to insure automated vehicles: Insurance code changes required
- G. Data privacy issues

#### 2. Country by country assessment

#### 3. 5 questions to solve the liability issue

- A, is there such thing as an ethical dilemma?
- B. Risks and responsibilities for the OEMs
- C. What are the risks for other stakeholders?
- D. How to demonstrate liability?
- E. What are the liability rules today?
- F. Recommendations on how to limit liability today with the deployment of ADAS functions

#### 4. Technical factors affecting the timeline

- A. Understanding the autonomous vehicle architecture
- B. The 5 necessary technological components of ADAS systems
- C. Safety technologies on the market
- D. Data management

#### E. Cost evolution and effect on ADAS adoption

#### SECTION VI: THE AUTONOMOUS VEHICLE VALUE CHAIN AND CHANNELS TO MARKET

- 1. The battle for control of the autonomous vehicle value chain
- A. Partnerships and acquisitions
- B. The competition for control
- 2. Mobility as a service: The route to market for driverless
- A, Car sharing
- **B.** Ride hailing
- C. OEMs are taking control of mobility services

#### SECTION VII: ADAS AND AV GLOBAL MARKET FORECASTS

- 1. Introduction and methodology
- 2. ADAS and AV global forecast main outputs
- A. Automotive market forecast B. How automation will affect the insurance market

#### SECTION VIII: CONCLUSIONS

#### 1. Timeline for the evolution of assistance and automation

- A. Expectations vary between stakeholders
- B. The evolution of the function stack
- C. Do we believe HAVs will arrive earlier than expected?
- D. The path to growth of the driverless car

#### 2. The main benefits of ADAS systems quantified

- A. Impact on claims
- B. Impact on premiums
- C. Return on investment for the driver
- D. Impact on the UBI market

#### 3. The key factors influencing ADAS/autonomy adoption

- A. Technology evolution
- B. Autonomous vehicles delivery strategy: key takeaways
- C. Machine driver delivery strategy: key takeaways
- D. Will automation increase vehicle prices?

#### 4. Liability and insurance takeaways

- A. How will HAVs be insured?
- B. Who is liable if a automated vehicles crashes?
- C. What will the OEMs do?

#### 5. Modelling the driverless vehicle introduction

A. Market entry strategies for the driverless car



# Over 600 pages of peer-reviewed analysis





# Outputs validated and illustrated by over 200 graphs





# The first global 2015-2030 AV bottom up forecast by level and vehicle segment in 18 regions





# 23 automotive OEMs and suppliers profiled and analysed







# 23 automotive OEMs and suppliers profiled and analysed





# The AV Global Study: a single, worldwide company licence



More than a report, a real strategic market analysis

Reports	Full Study with market forecasts	Full Study with slides & market forecasts*
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For more information and to order the study, contact thomas@ptolemus.com

# PTOLEMUS brings unparalleled depth of knowledge in connected and autonomous vehicle services



Economist, the Financial Times and the Wall Street Journal

research on insurance analytics

and AVs

connected car services

services

# Recognised research globally



# Shape the revolution with the AV Global Study



- Automation will radically change the automotive industry...
- ... and the complete mobility ecosystem
- Shape your company's strategy to be part of the survivors... and winners
- Make decisions based on the most complete intelligence on ADAS and automation
  - Verified facts & figures
  - Robust technology & regulatory assessments
  - Competitive benchmarks
  - Global market forecasts to 2030
  - Strategic analysis of the value chain evolution

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