

# Advances in Advanced Driver Assistance Systems and Automated Driving technologies within the European Context

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# Study Motivation

- EU road fatalities have **stagnated** despite safer vehicles.
- **Human error** contributes to >90% of crashes.
- ADAS and AD can **prevent collisions** rather than mitigate impacts.
- Need to **evaluate** technology, behaviour and regulation environment.



# Study Objectives

1. **Review** current ADAS and automation landscape.
2. **Assess** safety effectiveness and crash reduction.
3. **Discuss** human factors and societal impacts.
4. **Gauge** present EU regulatory framework and policy gaps.



# ADAS & Automation

- ADAS assist the driver while driver remains **responsible**.
- The EC mandates **key ADAS features** in all new vehicles from 2024

## SAE Levels:

- L1–2: driver assistance.
- L3: conditional automation with takeover.
- L4–5: high/full automation.



# Key ADAS advances

- Autonomous Emergency Braking (AEB)
- Lane Departure Warning (LDW)
- Driver Monitoring Systems (DMS)
- Adaptive Cruise Control (ACC)
- Lane Keeping Assist (LKA)
- Intelligent Speed Assistance/Adaptation (ISA)
- Emergency Lane Keeping System (ELK)
- Blind Spot Monitoring (BSM)

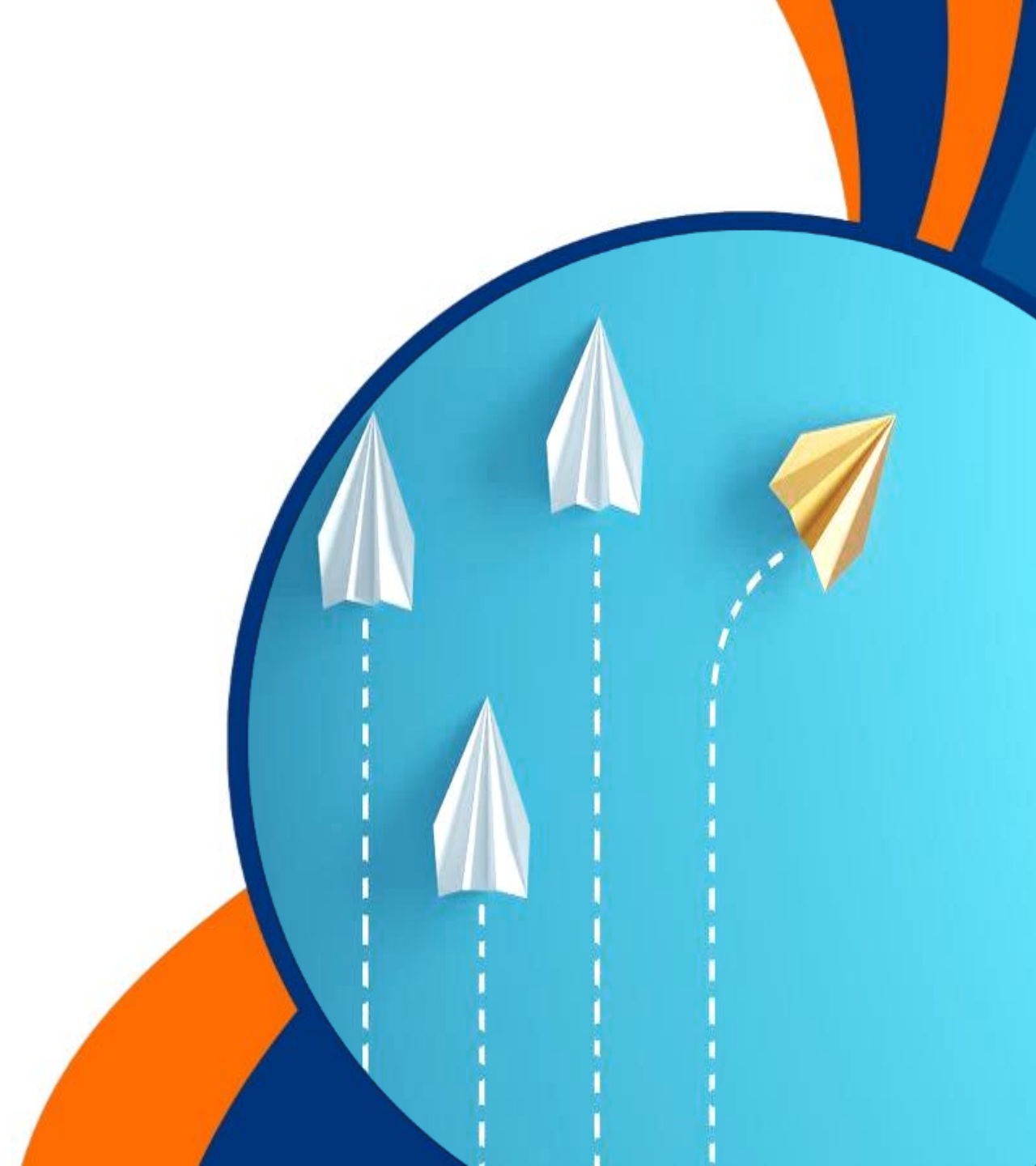
Mostly aim to **mitigate human errors or unsafe behaviours**



# The European Market

- European AV market is **growing rapidly**.
- EU invested €159M in CCAM since 2021.
- Level 3–4 pilots are expanding.
- ADAS **penetration increasing across vehicle fleets**.

... All previously mentioned technologies are **increasingly mandated** under the General Safety Regulation II (GSR2) (2019/2144)



# Related safety benefits

- AEB reduces **rear-end crashes** up to 52% (PARTS, 2025).
- LKA reduces **target crashes** ~60% (Dean & Riexinger, 2022).
- ISA **improves speed compliance** (ETSC, 2021).
- However, benefits depend on calibration and environment.



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# ADAS limitations

- Performance affected by **weather and road markings** [e.g for ISA, (ETSC, 2021)].
- Drivers **disable or misuse** systems (AAMI, 2025).
- L2 vehicle drivers may treat ADAS as **fully autonomous systems** and disengage mentally, leading to delayed reactions (Sekadakis & Yannis, 2025).
- Education remains **limited**.



# Safety projections

- Automation can reduce human-error crashes, leading to **net gains**.
- V2X enables **cooperative safety**.
- Benefits require **infrastructure readiness** (EuroNCAP, 2025).
- **Adoption rate** is critical (European Commission, 2018; Fundación MAPFRE, 2025).



# ADAS-AD Opportunities

- Over the air (OTA) software updates for **quick fixes** and improvements.
- Continuous learning from a **connected 'hive-mind'** where one incident improves network and fleet-wide safety (Himes, 2021).
- Improved protection for **VRUs** (AEB/NCAP assessed).
- Many ADAS technologies were initially conceived to enhance driver comfort by reducing workload and fatigue **yet ultimately improve safety**



# Human Factors

- Trust **calibration** is essential (DeGuzman & Donmez, 2024).
- Risk compensation may **increase distraction** (Dunn et al., 2019).
- Takeover time (TOT) has **high volatility** (ranging between 0.9 and 10 s) (Sekadakis & Yannis, 2025) and is critical for Level 3 and 4.
- UNECE Reg. 157 on LKA: If the driver does not take-over, the system do a **min-risk manoeuvre** no earlier than 10 seconds after the transition demand is issued (UN, 2021).



# Cybersecurity Factors

- UNECE R155/R156 **require cybersecurity** (UNECE, 2020a;b).
- Secure software updates **mandatory**.
- In-Vehicle Infotainment (IVI) **vulnerabilities remain** (especially given the rise of LLMs).
- Cybersecurity is **ultimately a safety issue**.



# Public Acceptance

- Acceptance **critically depends on trust**, but not only (range, comfort, price) (Ziakopoulos et al., 2023).
- **Digital inclusion** and the avoidance of digital gentrification are necessary.
- Older and rural users may be disadvantaged (O'Hern & St. Louis, 2023).
- Education improves adoption.



# Regulation status

- **GSR2** mandates core ADAS.
- **UNECE R157** governs ALKS.
- **Euro NCAP** drives voluntary adoption.
- **Vision Zero** guides policy.

Open question: Who coordinates **systemic safety and interoperability**?



# Monitoring Gaps

- Limited **real-world** monitoring.
- **No EU-wide crash repository** (but a unique opportunity to create one).
- Need for **post-market surveillance** to maintain public trust.
- **Open data** supports evaluation [such as the US (PARTS, 2025)].



# Policy Recommendations

- Strengthen **post-market monitoring** of automated vehicle crashes and near-miss incidents.
- Mandate **standardized driver training** for safe and effective ADAS use.
- Clarify **liability frameworks** supporting trustworthy deployment of automated driving technologies.
- Align **automated mobility** with Safe System and Vision Zero principles.



# Conclusions

- ADAS **appear to confirm the predictions** of significantly improve safety.
- Technology **alone is insufficient** and should not be promoted as sufficient.
- **Human-centred deployment** is essential.
- Innovation must align with Vision Zero and **interoperability in the future.**



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