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Differing Visions of the Future of Driving Instruction and Testing

Three Different Visions

The situation now	The situation now	The situation now
Fully autonomous-only cars limited to a few roads	Limited autonomous operation with human driver	Widespread basic automation with human driver
Fully autonomous-only cars on many roads	Widespread autonomous operation with human driver	Widespread extensive automation with human driver
Fully autonomous cars with no human controls	Fully autonomous cars with human controls and supervision	Highly automated cars with human drivers (mostly)

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Possible Influences on the Different Visions

- All vehicles electric with automatic gearboxes?
- Mixed human-driven and autonomous traffic?
- Human choice of automation mode?
- Reduction in cost of vehicles?
- Increase in acceptance?
- Construction of necessary infrastructure?

Dealing with different Driving Modes

- **normal operations**: situations in which all elements of the system (including people) are functioning as intended;
- **degraded modes of operation**: when problems in the underlying system occur – these are expected but are not considered normal;
- **crisis**: an adverse event… more serious than degraded modes, they last for a shorter time than contingency, but may be severe in nature;
- **contingency**: these may be more long-term than crises, and result in an interruption to [operation].

(Source: Eurocontrol (European Organisation for the Safety of Air Navigation), 2009)

Implications related to the GDE Matrix

Modes of operation	SAE level of automation – competences required		
	1 (Driver Assistance)	**3 (Conditional Automation)**	**5 (Full Automation)**
Normal Operations	Everything in GDE matrix	Everything in the GDE matrix plus the ability to transition between different levels of automation	No requirements on driver
Degraded modes of operation	Driver can deal with failure modes and is competent to substitute for failed systems (For example: tyre blowout, malfunction of proximity sensors).	Driver can compensate for minor and low-risk system failures.	Driver can make vehicle safe and safely exit vehicle.
Crisis	Driver can respond fast to minimise danger.	Driver can take over control quickly and safely.	Driver can alert necessary agencies and make self and vehicle safe.
Contingency	Driver can work around equipment and connectivity failure.	Driver can compensate for higher-risk system failures.	Driver knows how to arrange for repair or recovery.

New Training Requirements?

- Safe Operation of Automated Vehicles

  - Use of vehicle's software, applications and deactivating systems; Transitioning between automation modes; Controlling vehicle when towing; Dealing with loss of vehicle mapping functions; Managing unpredictable system errors (including emergencies)

- Specific Driving Skills

  - Defensive driving; the safe loading of vehicles; journey planning; situational judgement making; and the ability to respond quickly to hazards; rapid recovery of situational awareness; anticipation of the behaviour of other CAVs

- Specific Driver Responsibilities

  - Keeping hire vehicles clean, fully documented, fully equipped, and well maintained; controlling passenger behaviours; Continuous Personal development; managing breakdowns

- Specific Knowledge and Understanding

  - Retaining responsibility and control; driver engagement; Alertness to warnings, alarms and performance parameters; vehicle specific characteristics

Questions for Licensing Authorities

- Will safety permits be needed?
- How will continuous development be assessed?
- Will driving licences be graded (e.g. by SAE level)?
- Will the licensing system allow drivers to miss out levels?
- Will further testing be required to control all vehicles, at all levels of automation, in all modes of operation?
- Regardless of its level of automation, will drivers need to demonstrate that they can drive a vehicle at level 0?
- Who will be responsible for vehicle (and automation level) specific training and testing and how will that be quality assured?