A Review on Legal Consideration and Liability Allocation Connected and Automated Vehicles

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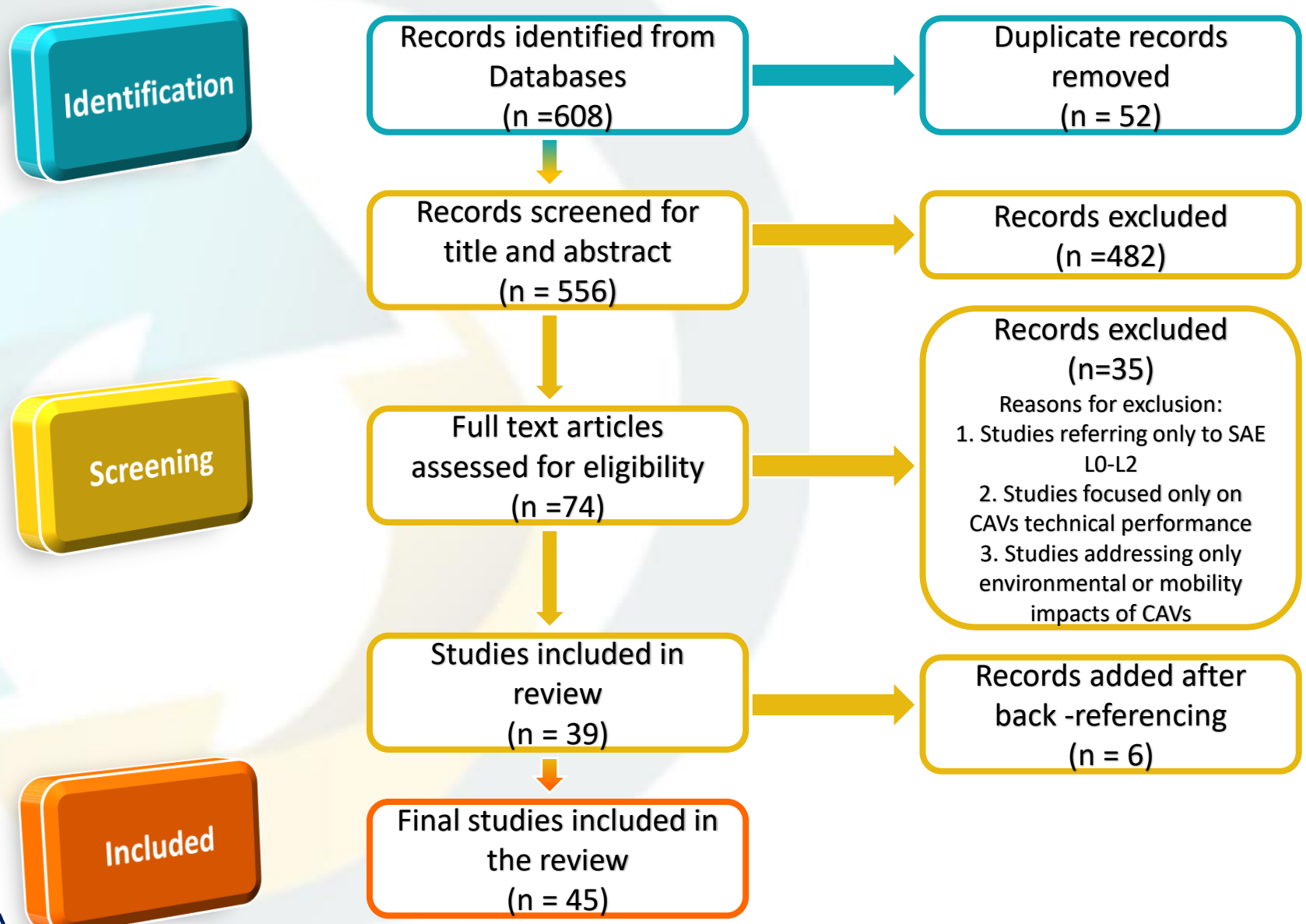
Introduction

- Connected and Automated Vehicles (CAVs) are reshaping transport by promising safer roads, reduced congestion, lower emissions, and improved mobility for vulnerable groups.
- Levels 3–5 automation can take over most or all driving tasks, aiming to eliminate human error as a primary cause of crashes.
- However, during the transition phase when human-driven and automated vehicles share roads, interactions with pedestrians, other VRUs and conventional vehicles will become complex.
- Legal uncertainty and poorly developed liability frameworks are major barriers to the safe and efficient deployment of CAVs.

Literature Review Methodology



Legal Frameworks across Jurisdictions

- Legal readiness for CAVs varies greatly between countries, both in terms of technical adoption and legal liability provisions.
- Europe (Germany, France) has developed advanced laws assigning responsibility to manufacturers, requiring safety approvals and data recording.
- China pursues rapid AV deployment but has inconsistent local regulations, while the U.S. relies on fragmented state laws with little federal guidance.
- The Vienna Convention (2016) allows automated systems if human override is possible, but most countries still rely on soft, non-binding guidelines, leaving cross-border liability unclear.

Liability Allocation Models

- Traditional liability frameworks assume a human driver is always at fault, which is incompatible with shared or fully automated driving.
- Studies show that even when systems are in control, public opinion often still blames the human occupant ("moral crumple zone").
- Proposed solutions include shifting the burden of proof to manufacturers, using comparative negligence to share fault, or creating enterprise liability where one entity takes full responsibility.
- Clear legal definitions of "driver" and "control" are urgently needed, alongside international harmonization to prevent legal uncertainty from slowing adoption.

HMI and Legal Ambiguity

- SAE Level 3–4 systems require drivers to retake control in emergencies, but studies show they often respond slowly after long periods of disengagement.
- Current laws do not clarify whether liability lies with the driver for failing to react or with the system for issuing an unsafe handover.
- Poor interface design and weak warning systems worsen this issue, suggesting liability could shift to manufacturers or software developers.
- Legal solutions proposed include event data recorders (EDRs), biometric driver logging, and formal traffic rule logic to document who had control and when.

Ethical and Social Considerations

- AVs introduce new ethical questions, such as how they should behave in unavoidable crash scenarios — often discussed via the "trolley problem."
- Public attitudes are inconsistent: people say they want AVs to act for the greater good, but also want their own vehicles to prioritize their safety.
- Ethical preferences vary across cultures (e.g. Japan collectivists vs US individualists), making global ethical rules difficult to enforce, while manufacturers often focus more on minimizing risk and liability than on abstract ethics.
- Social equity issues also arise: CAVs could expand access for elderly and disabled users but may worsen inequality and public health if they reduce walking, cycling, and public transit use.

Insurance and Economic Impacts

- Traditional car insurance relies on assigning fault to an individual driver, which does not fit CAVs that involve multiple actors like OEMs, software firms, and infrastructure managers.
- The insurance industry is experimenting with new approaches: shared liability, product liability that shifts responsibility to manufacturers, and real-time data sharing.
- Risk models are being redesigned to incorporate telematics and contextual data rather than just human driving records.
- While widespread CAV use could save costs from fewer crashes and optimized travel, legal uncertainty currently delays insurance innovation and raises premiums.

Discussion (1/2)

- Regulatory frameworks are fragmented across jurisdictions, leaving manufacturers and users to navigate conflicting standards and unclear safety requirements.
- Legal systems still rely on human-fault logic, which does not align with automation where control is shared or entirely delegated to machines.
- Lack of standardized EDRs and data access protocols undermines fair investigations and insurance claims.
- Ethical rules are underdeveloped and culturally inconsistent, while the insurance industry struggles to adapt to complex multi-party liability networks.

Discussion (2/2)

- International harmonization of legal definitions, safety requirements, and liability rules is essential to enable cross-border CAV deployment.
- Flexible, evidence-based liability systems should replace rigid driver-fault models, distributing responsibility among all actors involved.
- Standardized tamper-proof EDRs and clear data access rights can provide reliable evidence for insurers and courts.
- Public trust must be strengthened through education, demonstrations, ethical transparency, and engagement of ethicists, engineers, and policymakers in decision-making.

Conclusions

- CAVs offer transformative safety and mobility benefits, but legal, ethical, and insurance systems remain unprepared for their widespread use.
- Liability frameworks are still fragmented and human-centered, hindering innovation and public acceptance.
- Research is needed to test how liability models affect safety, user behavior, and manufacturer incentives in real traffic.
- Clear, harmonized legal rules are critical for building trust, ensuring safety, and realizing the promised benefits of automated mobility.
- Updated regulatory frameworks should consider manufacturers' holistic safety initiatives (e.g. Waymo)

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