
Regulatory Challenges for Road Vehicle Automation: Lessons from the California Experience

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Regulatory Challenges

- **Automation breaks the traditional boundary between vehicle equipment and driving behavior**
- **Need to balance protecting public safety and encouraging innovation in vehicle technology**
- **Absence of technical standards**
- **Extremely high safety needed just to equal today's manual driving (in U.S.):**
 - **3.3 million vehicle hours between fatal crashes (375 years of 24/7 driving)**
 - **64,400 vehicle hours between injury crashes (7+ years of 24/7 driving)**

California Background

- **SB 1298 amended Vehicle Code in July 2012**
- **Rules apply to SAE Level 3+ driving automation**
- **Testing regulations effective Sept. 2014**
 - **Permission for specific vehicles, drivers**
 - **Strict test driver requirements**
 - **Describe prior closed-course testing**
 - **No heavy vehicle, motorcycle testing now**
 - **Report certain driver interventions, but all crashes**
- **Permits for 10 manufacturers, 102 vehicles, 334 test drivers**

Deployment Regulation Principles

- **Public safety now depends on the technology, not on the trained test drivers**
- **Treat all developers equally**
- **Clear and unambiguous requirements representing real transportation needs to avoid temptations to “game the test”**
- **Compliance testing process clearly defined and not excessively complicated**
- **Transparency of results to gain public confidence, without jeopardizing developers’ intellectual property**

Our Recommendations on Easy Topics

- **No special driver licensing, training, or testing**
 - **But manufacturers should disclose all information provided to customers**
- **No special external markings on vehicles**
 - **Except if they can operate without driver**
- **Self-diagnostic capabilities to recognize calibration or tampering problems**
 - **Preclude operation of impaired vehicles**
- **Preclude operation outside operational design domain**

Open Questions

- **How to ensure that the AVs will not decrease safety?**
 - **Functional safety with respect to internal faults**
 - **Driving behavioral competency for handling external hazards**
- **Certification**
 - **What needs to be certified?**
 - **Who should perform the certification?**

Functional Safety

- **ISO 26262 as a starting point, but...**
 - **It is a process standard, not a performance standard, with no pass/fail criteria**
 - **Complicated and costly to apply**
 - **Designed for subsystems of limited complexity, not complex systems of systems**
 - **Automotive Safety Integrity Levels (ASIL) assume driver availability for fallback**
- **Therefore, it is not yet sufficient**

Managing External Hazards

- **Consider diversity of operational design domains**
 - **Urban, suburban, rural, or motorway**
 - **Traffic conditions, other road users**
 - **Weather and lighting conditions....**
- **What basic driving maneuvers are required for each, to screen out the incompetent?**
 - **Common hazard responses**
- **How to define pass/fail criteria?**
- **Is there a role for simulation?**
 - **How to validate the simulation?**

What should be certified?

- **Functional safety system development process?**
 - **Minimal relevant experience in U.S.**
 - **Functional safety of the specific system design?**
 - **Complicated, expensive, and needs IP protection**
 - **Performance testing relative to required behavioral competencies?**
 - **Complicated and expensive if the tests are to be complete enough to be meaningful**
 - **Simulations of required behavioral competencies and performance under many scenarios?**
 - **How to certify realism of simulation?**
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Who should do the certification?

- **Manufacturer self-certification**
 - Typical for FMVSS safety standards in U.S.
 - Needs independent verification by agency
 - Public release of relevant data??
- **Third-party certification**
 - Common in Europe, not in U.S.
 - Third party needs proper certification
 - Could be hired by government or company
- **Government certification**
 - Needs public investment to build capabilities
 - Used for emissions in U.S.