AUTONOMOUS DRIVING

COLLABORATIVE APPROACH NEEDED FOR BIG BUSINESS

Innovation Bazaar, Vehicle ICT Arena

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Research Institutes of Sweden
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AUTONOMOUS DRIVING AND ADAS

Totally different thinking and different approach needed
Understanding takes time and effort....
TRUST
Autonomous Driving

- Selfdriving and driverless cars are a big opportunity for sustainable mobility and radically change our use of vehicles
- Autonomous driving is a complex issue
- Any accident with fatalities may affect others, “lex Harrisburg”
- Validation and verification of vehicles, infrastructure and legal framework require large resources, hence a growing large global business
- Nobody can do it on their own

How safe is safe enough?
- No silver bullet
- Quadruple helix collaboration required; Public/Private/Research/Users
- Orchestrated efforts for win-win-win…

This is an invitation from RISE to join our emerging ECO-system to develop an Autonomous Driving
RISE - Test beds and Expertise

- **AstaZero Active Safety Test Area**
  AstaZero is a company that has built a state-of-the-art Proving Ground specifically designed for developments in active traffic safety.

- **AWITAR Automotive Wireless Test and Research Facility**
  We are now engaged in building a world-leading test and research facility for wireless communication systems and EMC for e.g. autonomous vehicles and active safety systems.

- **RISE Certification**
  RISE Certification is one of the leading bodies in the field of certification in Sweden, with long experience of the work. We issue certificates of compliance with a large number of standards.

- **Expertise (applicable main areas)**
  - Electrical architecture
  - Systems of systems
  - Functional safety
  - Cybersecurity
  - Big Data and Deep Machine Learning
  - Communication simulation
  - Communication systems
  - Positioning
  - Human factors and user behavior studies
Safety target

- 94% of all serious accidents are caused by manual mistakes.
- 70,000 km in average between incidents with manual drivers
- Safety target for AD should be more than 70,000 km between incidents and nobody killed

Source: Gérard Yahiaoui: Bad interpretation of percentages may lead to terrible misunderstanding: use case of self-driving car, LinkedIn 2017-10-28 [Länk]

Source: Kalra et. al. Driving to Safety..., [www.rand.org]
Overview on main areas of legal risks

Civil Law
(e.g. contract, general tort and product liability law)

"... no discrepancy between promised and actual state ..."
"... when it does not provide the safety which a person is entitled to expect ..."

Regulatory Law
(e.g. product safety law, occupational safety, marking and labeling regimes)

"... does not present any risk or only the minimum risks ... with a high level of protection for the safety and health of persons ..."

Product Liability
Product Safety
Product Compliance

Criminal and Administrative Offence Law

"... violation of a duty of care ..."

Other Areas
(e.g. competition law, IP, capital market, PR, etc.)

International agreements (GC, VC, UNECE, etc.)
EU directives and regulations (particularly type-approval)
National laws (particularly vehicle registration)
Technical standards (e.g. ISO, EN, DIN)
State of the Art

*Reference Patrick Ayad, Hogan Lowells
Testing of ADAS and AD is a large and growing business

**Today**
- Mostly internal work at the OEMs and Tier1s
- Supplier industry existing for simulators and engineering tools
- Critical use cases for test tracks and simulators are tuned based on collected data from traffic data and accident analysis
- Certification.....
- EuroNCAP has become the rating de-facto standard

**Trend**
- Exponential growing testing
- Rating is a growing business
- Certification….product or process?
- OEMs use independent test tracks and facilities (less investment in own facilities)
- Up-coming OEMs want more 3rd party services
- More Tier2 testing (e.g. sensors)
- Simulators and engineering tools – interface standards are emerging
- Validation and reference data might be a new service business
Definitions and schools of thought Automated Driving
Automation levels and implementation forecast

SAE Automation Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Establish</th>
<th>2018</th>
<th>2020</th>
<th>2022</th>
<th>2024</th>
<th>2026</th>
<th>2028</th>
<th>2030</th>
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<tbody>
<tr>
<td>0</td>
<td>No Automation; the driver performs all driving tasks.</td>
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<tr>
<td>1</td>
<td>Driver Assistance; the driver performs all driving tasks, but some driving assist features may be included in the vehicle design.</td>
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<td>2</td>
<td>Partial Automation; the driver performs all driving tasks, but some driving assist features may be included in the vehicle design.</td>
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<td>3</td>
<td>Conditional Automation; the driver is required to monitor the environment but is not required to control the vehicle.</td>
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<td>4</td>
<td>High Automation; the vehicle is capable of performing all driving functions under certain conditions.</td>
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<tr>
<td>5</td>
<td>Full Automation; the vehicle is capable of performing all driving functions under all conditions.</td>
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[www.ertrac.org]
Schools of thought 1: Roles and regulation

**Driver**
- Drivers license
- Private/commercial
- Eco-driving...

**Vehicle**
- Type approval
- Private/commercial
- Annual tests

**Infrastructure**
- Traffic rules
- Road classifications
- ITS-systems

![Diagram showing relationships between Driver, Vehicle, and Infrastructure](image-url)
Schools of thought 2: Systems boundary
Schools of thought 3: Everything vs Something

Everything somewhere  

Something everywhere
A new way of working?
Regulation of Autonomous Driving

- It is unclear how the development of vehicles will turn out – making it difficult to predict the future. **Unpredictability makes regulation challenging.**
  - When to regulate?
  - What to regulate?
  - Who to involve?
  - At what scale?
  - ....

- The current regulation strategy will most probably need to evolve to accommodate fast development of software.

- Majority of countries have not a clear picture of what needs to be done to assure safety.
  - The Netherlands: suggested a performance-based approach
  - Germany: May be the approach suggested in PEGASUS (seems to be performance-based)
  - Others (Singapore, states in the US, UK): manufacturer needs to show that the vehicle is safe (BUT what/how?)

- There are several ways of regulating new technologies – each of them has own pros and cons.
  - Command-and-control
  - Performance-based
  - Accreditation
  - Self-certification

Which of these approaches is most suitable for AV?
Type approval in relation to automated vehicles

Type approval in the EU today:

1. A rather static process for new regulation.
2. Authorities describe both “What” to test and “How” to test.
3. Approval based on a certain number of ”type cases”.
4. Approval takes into account the component/vehicle.
5. A component/vehicle is approved once (and then “checked” at periodical technical inspections).

Potential challenges:

1. Is not fast enough to capture the fast development of software.
2. Describing “What” and “How” does not leave enough play ground for innovation.
3. Proving that an AI-system works in a few cases does not tell how it works in other cases.
4. Does not take into account the system in which the vehicle operate (humans, infrastructure, other vehicles)
5. Does not have a continuous monitoring during the lifetime of the vehicle – changes are not captured.
6. Not a strong (market-focused) penalty system.

Current type approval in the EU is based on hierarchical "top-down" control – detailed, requires a lot of knowledge and responsibility from authorities.
Future: A shift towards a more performance-based strategy?

- Adopt a system perspective: vehicle, humans, infrastructure
- More proactive, less detailed – ask questions, not give answers.
- *Process* approval instead of *product* approval
- Embrace an iterative, learn-by-doing regulation strategy:
  1. Virtual testing for certain operative domain
  2. Test-track testing for certain operative domain
  3. Field testing in certain operative
  4. Admission for certain operative domain

Learn-by-doing

Feedback

Functional Regulation
What the AV *does*

Ever-changing, ever-learning vehicles

Detailed Regulation
What the AV *is*

Manually operated vehicles

Feedback for further development of regulation strategy regulation strategy
Euro NCAP Roadmap 2020

- Supporting high levels of automation and connectivity in cars – safe and reliable operation

Timeline for inclusion of driver support systems...
CHALLENGES

Major challenges for Autonomous Driving
Seven Challenges for AD implementation

1. Customer data from AD will be needed
   - What and how will it be accepted?
2. Need to integrate data from complete chain – MIL, SIL, HIL, test tracks, test-driving, customer data
   - How do we define and re-use critical use cases?
3. Huge amount of data
   - Storage? Filtering? …
4. Classical systems engineering and formal methods do not scale
   - Statistical methods instead? Hybrid?
5. Continuous up-dates will be neccessary
   - Test, verification, validation processes?
6. Classical type approval not possible
   - Legal innovation and global diplomacy?
7. Cybersecurity
   - RISE with ECO system able to present action?

Are we in the Swedish cluster prepared to move fast enough?