Highly automated Driving must be acceptable for the user, the society and the other traffic participants

Which risks are acceptable and what are the resulting requirements for the highway pilot?

- Relevant criteria for the acceptance of risks are:
  - Freedom of choice,
  - Controllability and
  - Individual benefits

- It has to be distinguished between individual and collective requirements

- Usage of accepted measures for risk

**GAMAB-principle (performing globally at least as good as)**
- Derived from today’s risk on the Autobahn
- Describes collective risk for accidents with different severities

**Minimum Endogenous Mortality (MEM)**
- The minimum natural mortality in GER is about $6 \times 10^{-5} / \text{(Person x Year)}$ (Source: Sterbetafel, Statistisches Bundesamt)
- As each individual is exposed to more than one risk, a value $\leq \text{MEM} / 20$ should not be exceeded by a new technology (Source: EN 50126)
- Acceptable individual fatal risk: $\leq 3 \times 10^{-6} / \text{(Person x Year)}$

**Severity (kind of injury)**

<table>
<thead>
<tr>
<th>Severity (kind of injury)</th>
<th>Average Distance between 2 accidents</th>
<th>Accident rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>fatal</td>
<td>$660 \cdot 10^6 \text{ km}$</td>
<td>$1.52 \cdot 10^{-9} \text{/km}$</td>
</tr>
<tr>
<td>heavy</td>
<td>$53.2 \cdot 10^6 \text{ km}$</td>
<td>$1.88 \cdot 10^{-8} \text{/km}$</td>
</tr>
<tr>
<td>light</td>
<td>$12.5 \cdot 10^6 \text{ km}$</td>
<td>$8.00 \cdot 10^{-7} \text{/km}$</td>
</tr>
<tr>
<td>none</td>
<td>$7.5 \cdot 10^6 \text{ km}$</td>
<td>$1.33 \cdot 10^{-6} \text{/km}$</td>
</tr>
</tbody>
</table>

Source: H.-P. Schöner, CESA 2014; Statistisches Bundesamt 2013

Highly automated Driving must be acceptable for the society

Which risks are socially acceptable and what are the resulting requirements for the highway pilot?

The road risk is currently decreasing, however this decreasing trend is diminishing in the last decade

- **Thesis**: Without HAD, this trend will further diminish, until the risk stagnates
- **Long-term**, the risk of HAD should be below today’s risk to ensure that a decreasing **long-term** trend is kept.

Additional aspects of road safety should be considered

- Risks for the user and other traffic participants
- Change in the severity distribution of accidents, especially when it concerns fatal accidents or injuries
- Equipment rate and driving profile of HAD
Highly automated Driving must be acceptable for the society

Which risks are socially acceptable and what are the resulting requirements for the highway pilot?

With the begin of the introduction of HAD, effects for the society are small, because the possible change in risk is only affected by a small number of vehicles

- With higher equipment rate, the requirements could increase

Comparing the risk of other technologies, e.g. of other traffic systems, can be helpful to define an acceptable risk for the introduction

Highly automated Driving must be acceptable for the user

Which risks are acceptable for the user and what are the resulting requirements for the highway pilot?

Different Users might accept different risks, because they have a direct benefit from the technology.

Business related exposition is likely possible, hence a risk of $1 \times 10^{-5}$ fatal accidents/(Year x Person) is proposed.

Comparing the risk of other technologies, e.g. of other traffic systems or with other technologies with high perceived benefit such as mobile phones, can be helpful to define an acceptable risk for the introduction phase.

Safety on Autobahn today (GAMAB)

Motorbike (all Road, with assumed equal mileage)

1. Statistic of fatal accidents

2. Statistic of accidents with injuries

Conversion of the acceptable collateral risk:
- Average mileage on Autobahn 4,000 km / (Year x Person)
- 1.5 x $10^{-9}$ Fatalities/km x 4,000 km/(Year x Person) = $6 \times 10^{-6}$ Fatalities/(Year x Person)

Highly automated Driving must be acceptable for the other traffic participants

Which risks are acceptable for the other traffic participants and what are the resulting requirements for the highway pilot?

The encounter of a HAD-Vehicle is an involuntary exposition with a new technology without an individual benefit.
- According to Fritzsche a risk of $1 \times 10^{-6}$ Fatalities / (Year x Person) is acceptable.
- This concerns new risks, which are not present without HAD (comp. booth “Automation Risks”)

The actual risk is not only dependent from the risk of the individual HAD function but also from the equipment rate
- The new risk for other traffic participants is lower, for lower equipment rates

What is the risk in road traffic compared to other risks today?
A randomly selected German...