HeavyRoute
Driving simulator study
Which HMI has the greatest potential to lead to safe driving?
Displays

Roll-over risk

Recommended speed

Steep Slope

Strong wind

vti
## Design

<table>
<thead>
<tr>
<th>Driver nr</th>
<th>M/F</th>
<th>IE/E</th>
<th>Timing</th>
<th>Part 1</th>
<th>Part 2</th>
<th>Part 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Type</td>
<td>Road</td>
<td>Type</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Road</td>
<td>Type</td>
<td>Road</td>
</tr>
<tr>
<td>1</td>
<td>M</td>
<td>IE</td>
<td>1</td>
<td>0</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>F</td>
<td>E</td>
<td>2</td>
<td>1+2</td>
<td>C</td>
<td>1</td>
</tr>
</tbody>
</table>

**Timing:**
- 1 – 8 s: 0 – no warning
- 2 – 5 s: 1 – symbol
- 2 – recommended speed

**Type:**
- 0 – no warning
- 1 – symbol
- 1+2 – recommended speed

**Road:**
- A: C – S – C – W
- B: C – W – S – C
- C: W – C – S – C
Driver behaviour

- Speed (mean and variation)
- Lateral position (mean and variation)
- Lateral acceleration
- Acceleration/retardation
- Use of brakes
- Steering wheel angle
View from inside the truck
View from inside the truck cabin
Mean speed (km/h) when entering the curve

- Inexperienced drivers
  - No warning system
  - Warning sign
  - Warning sign and recommended speed
- Experienced drivers
  - No warning system
  - Warning sign
  - Warning sign and recommended speed

- Upper
- Mean
- Lower
Conclusions

Inexperienced drivers
• significantly higher speed without warning system than with a warning sign
• no significant effect to add recommended speed to the warning sign

Experienced drivers
• significantly higher speed without warning system than with warning sign in combination with recommended speed
• no significant difference without system and only a warning sign
• no significant effect to add recommended speed to the warning sign
## Questionnaire

1. What is your **attitude** towards the roll-over warning system that you have tested?

<table>
<thead>
<tr>
<th>Very negative</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Very positive</th>
</tr>
</thead>
</table>

2. How **useful** did you find the roll-over warning system?

<table>
<thead>
<tr>
<th>Not useful at all</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Very useful</th>
</tr>
</thead>
</table>

3. What is your opinion on the **timing**?

<table>
<thead>
<tr>
<th>Much too late</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Much too early</th>
</tr>
</thead>
</table>

4. How much did you **rely** on the roll-over warning system?

<table>
<thead>
<tr>
<th>Not at all</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Completely</th>
</tr>
</thead>
</table>
5. How much do you think the following factors would be influenced by having a roll-over warning system?

<table>
<thead>
<tr>
<th></th>
<th>great decrease</th>
<th>no change</th>
<th>great increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

A Traffic safety  
B Your comfort  
C Your attention  
D Your travel time  
E Your stress level

6. Can you see any risks with a roll-over warning system?  
   YES  
   NO

If yes, describe:

________________________________________________________________________________________
Conclusions

• Drivers of HGV’s are positive towards having warning systems. It is assumed to have a positive influence on safety, but no great influence on driving comfort, driver attention and travel time.

• Drivers adapt their speed better to critical situations, in particular in situations with sharp curves where there is a risk for roll-over if entered at too high speed.

• It is sufficient to show a warning symbol, although inexperienced driver prefer a recommended speed.

• It is important that the warning is given at a timing that gives the driver sufficient time to respond to the warning and adapt the speed. Even the longest timing in this study, 8 s, was considered too short.
## Useful route guidance functions

<table>
<thead>
<tr>
<th>Feature</th>
<th>Minimum</th>
<th>Mean</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessible route</td>
<td>1,0</td>
<td>1,9</td>
<td>5,0</td>
</tr>
<tr>
<td>Fastest route</td>
<td>1,0</td>
<td>2,6</td>
<td>6,0</td>
</tr>
<tr>
<td>Least fuel consumption</td>
<td>1,5</td>
<td>3,5</td>
<td>6,0</td>
</tr>
<tr>
<td>Shortest route</td>
<td>1,0</td>
<td>3,6</td>
<td>6,0</td>
</tr>
<tr>
<td>Least environmental impact</td>
<td>2,0</td>
<td>4,3</td>
<td>6,0</td>
</tr>
<tr>
<td>Least infrastructure damage</td>
<td>2,0</td>
<td>5,1</td>
<td>6,0</td>
</tr>
</tbody>
</table>
Result: Timing 8 s + warning sign only