Safety assessment of infrastructure and interactions

P. Morsink, S. Bhusari, M. Oskina

Emails: maria.oskina @rhdhv.com; peter.morsink @rhdhv.com; shubham.bhusari @rhdhv.com
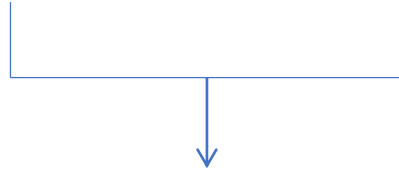
Contents

- Assessment
  - Physical infrastructure
  - Safety interactions with cyclists
  - Willingness to choose a self-driving bus
- Future steps

Assessment: Physical infrastructure

The checklist

Route alternatives

Vehicle specifications

Qualitative & Quantitative

Infrastructure readiness for automated driving

Sections:
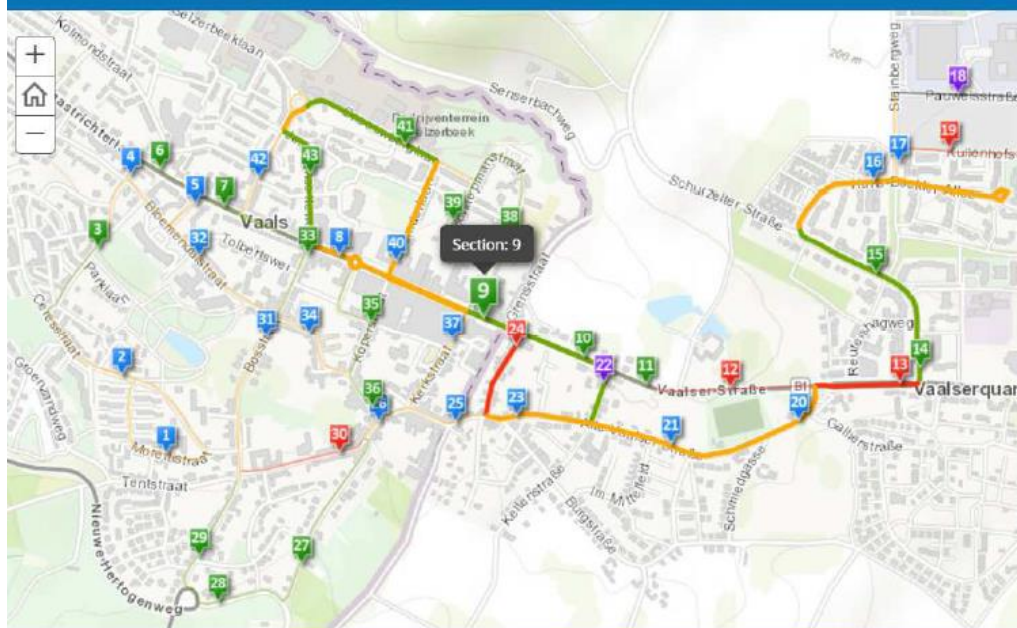- Straight parts of the route, separated by an intersection.
- Turns
- Roundabout

Road type and traffic priorities
- Driving direction
- Road side parking
- Extra adjacent space
- On-road parking
- Vegetation
- Free space: carriageway width
- Lane height
- Number of possible traffic encounter directions
- Priority on lane
- Possible driving speed

Interaction with other road users
- Carriageway width
- Obstruction
- Free space: carriageway width
- Lane regulation
- Possible vehicle types on the road
- Length of sub section

Obstruction
- Evade. This represents the type of vehicle that the shuttle has to evade while driving in a specific sub-section
- Width of vehicles parked on the road – max. width of the possible vehicle types on the road

Infra readiness map
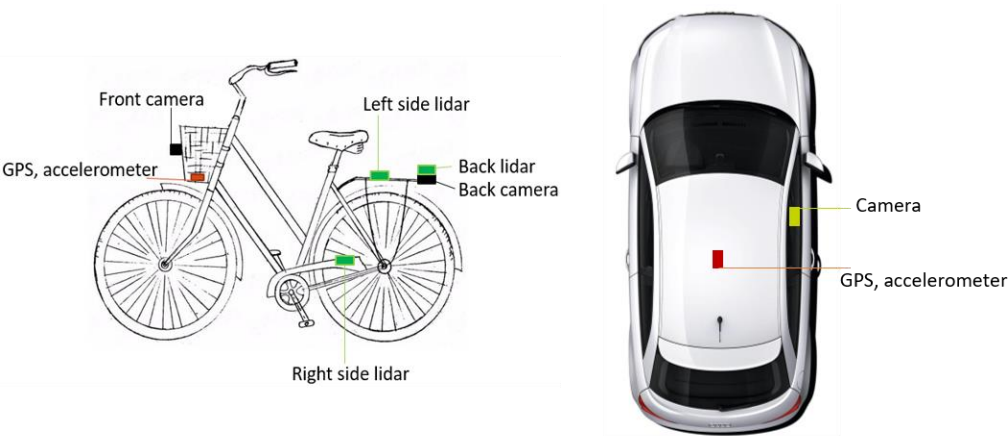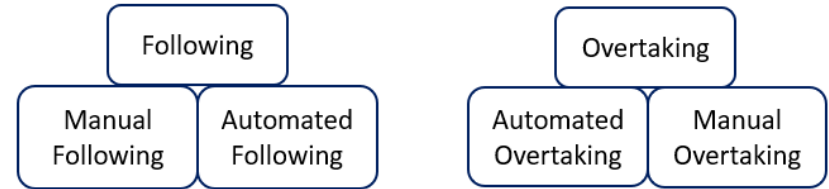
Assessment: Safety of interactions with cyclists

Experimental setup

Equipped bicycle and vehicle

Interaction scenarios and attributes

Following
- Manual Following
- Automated Following

Overtaking
- Automated Overtaking
- Manual Overtaking
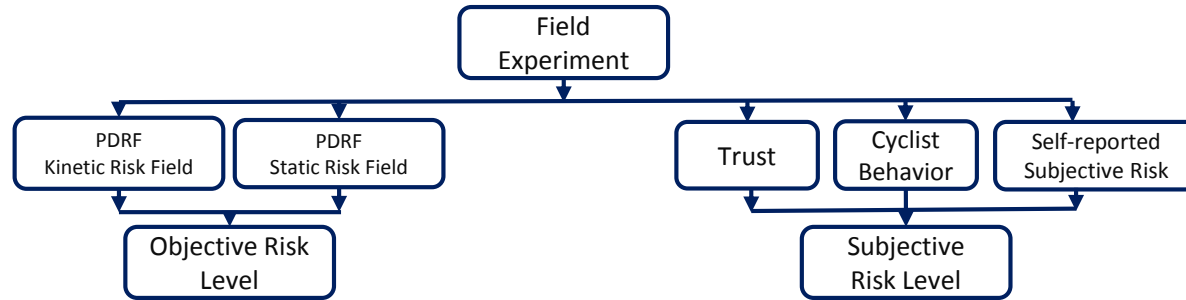
Interaction attributes:

- Overtaking speed
- Relative distance
- Right hand side objects

Risk Assessment: Which interaction scenario minimizes risks of interaction?

Field Experiment

PDRF Kinetic Risk Field

PDRF Static Risk Field

Trust

Cyclist Behavior

Self-reported Subjective Risk

Objective Risk Level

Subjective Risk Level

Risk = Magnitude * Probability

Objective Risk (Joules) — % of the route

Distance to the curb (m) — % of the route

Cyclist sped (m/s) — % of the route

Royal HaskoningDHV
Enhancing Society Together
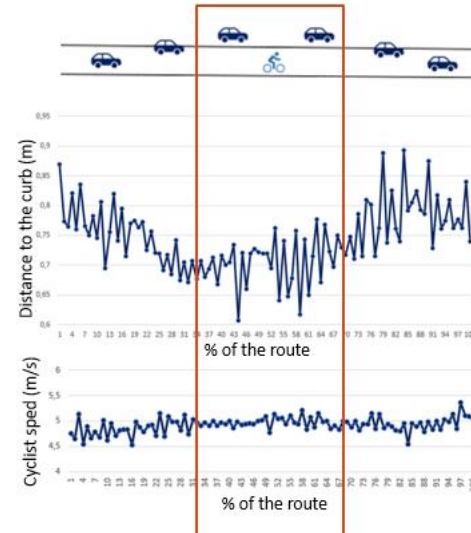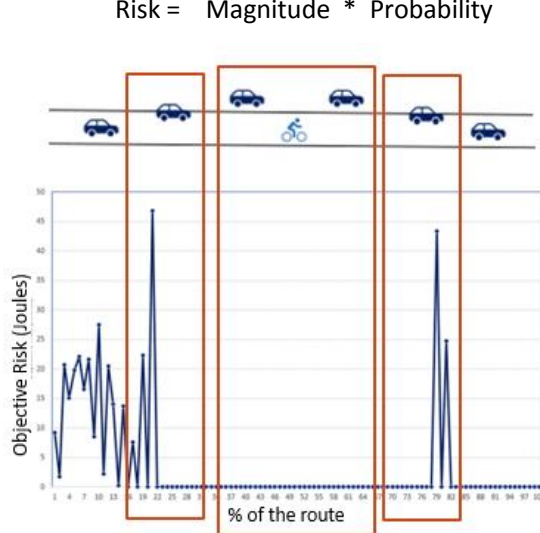
Outcomes of the interaction assessment

Following; Automated mode	Overtaking; Manual mode

Time of interaction	Short street	Long street

Overtaking distance	Narrow street	Wide street

The RHS objects	Additional attention at the streets with the green grass
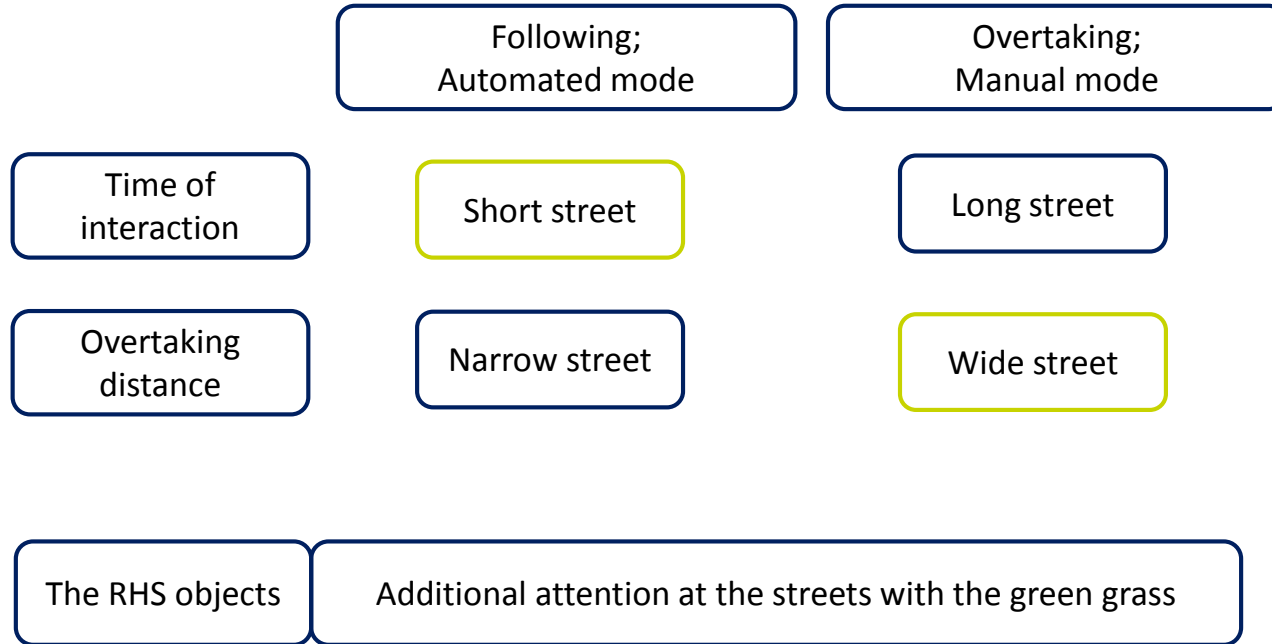
Assessment: Willingness to choose self-driving bus

Stated choice experiment

282 respondents
1692 choice observations
-72% use public transport every week
- 62% employees
- 36% students
- 90% have a high education level

Representative for commuters travelling to work or study

Alternative differentiated by *attributes*

Example

	Self-driving bus	Regular bus
Travel time	10 minutes	7 minutes
Travel costs	€ 2.20	€ 1.60
Waiting time	2 minutes	6 minutes
Surveillance & Information	Steward	
Service	On-demand	

○ Self-driving bus

○ Regular bus

○ I would choose another mode to travel

Research question: To which extent do public transport users prefer a self-driving bus relative to a regular bus for sub-urban trips?

- The self-driving bus is preferred over the regular bus in short urban trips
- Travel time is perceived worse in a self-driving bus than in a regular bus based on Value of Travel Time

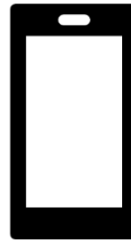Preference for the self-driving bus can be influenced by:
- No extra surveillance
- Offering a scheduled service
- Having trust in automated vehicles
- Gender

Future steps

| Series of trainings and Vehicle driver manual | Digital screen for real-time risk assessment | Infra readiness map, advanced route assessment |