

# Vision Zero: Technologies and Limitations

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AAMA 2013

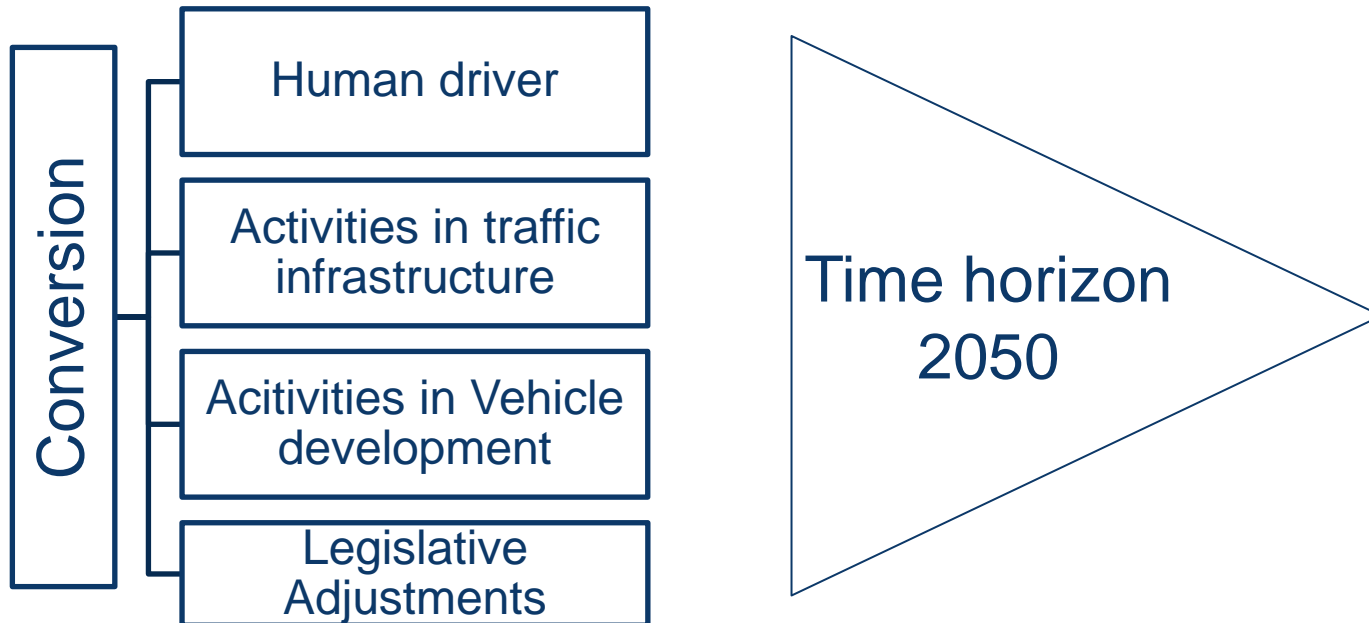
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# Vision Zero

No fatalities or serious injuries in road traffic

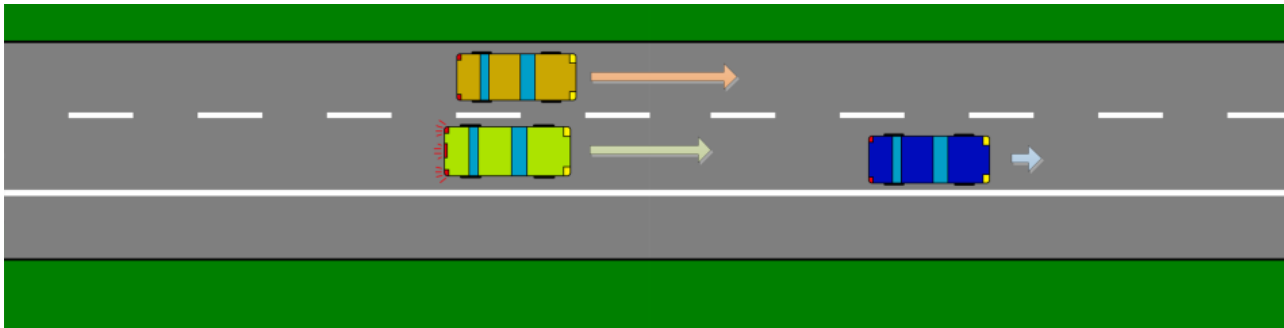
see „EU White Paper on Transport 2011“



## object of investigation

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Is a Vehicle safety concept conceivable, such that Vision Zero can be implemented?



## Boundary conditions

- Restriction to longitudinal traffic
- no wrong-way drivers, no pedestrians, no cyclists, no wild animals
- no extreme weather situations, no low friction coefficients
- deliberate violations of traffic rules are not considered

# Procedure model Vision Zero

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## State of the art



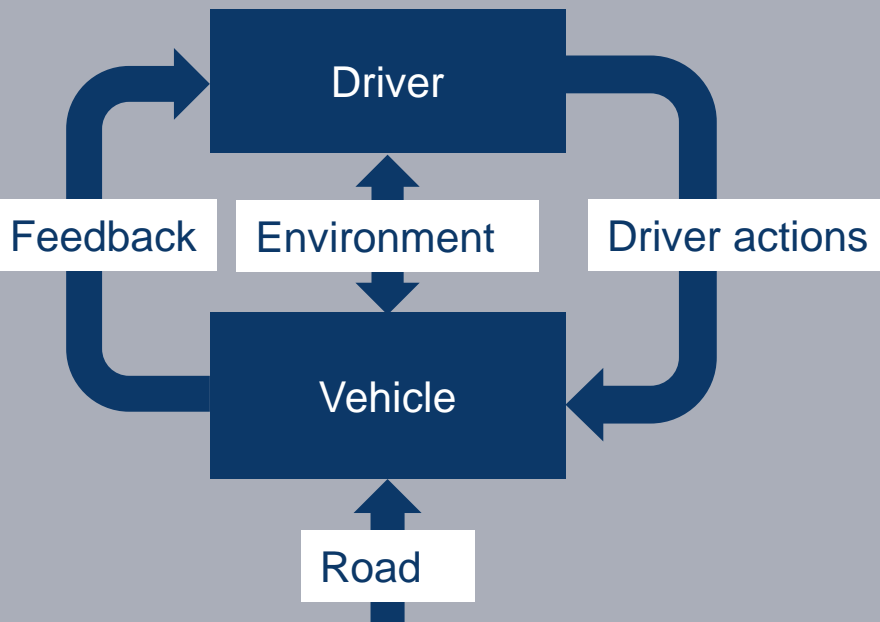
## required model



Goal: Systematic Avoidance of serious injuries and fatalities in traffic

# Analysis of the situation (1)

## Vehicle as control loop



## Different Scenarios

- Initial state – free driving on right lane
- *scenario 1 – driving obstacle on right lane*
- *scenario 2 – Following hindrance on right lane*
- *scenario 3 – Lane change to the left*
- *scenario 4 – free driving on left lane*
- *scenario 5 – Following hindrance on left lane*
- *scenario 6 – lane change to the right*
- *scenario 7 – stationary object on the right lane*
- *scenario 8 – emergency braking manoeuver*
- ~~*scenario 9 – collision*~~

Cancellation of scenario 9, since in case of a collision the fulfillment of Vision Zero **cannot be guaranteed in any case**

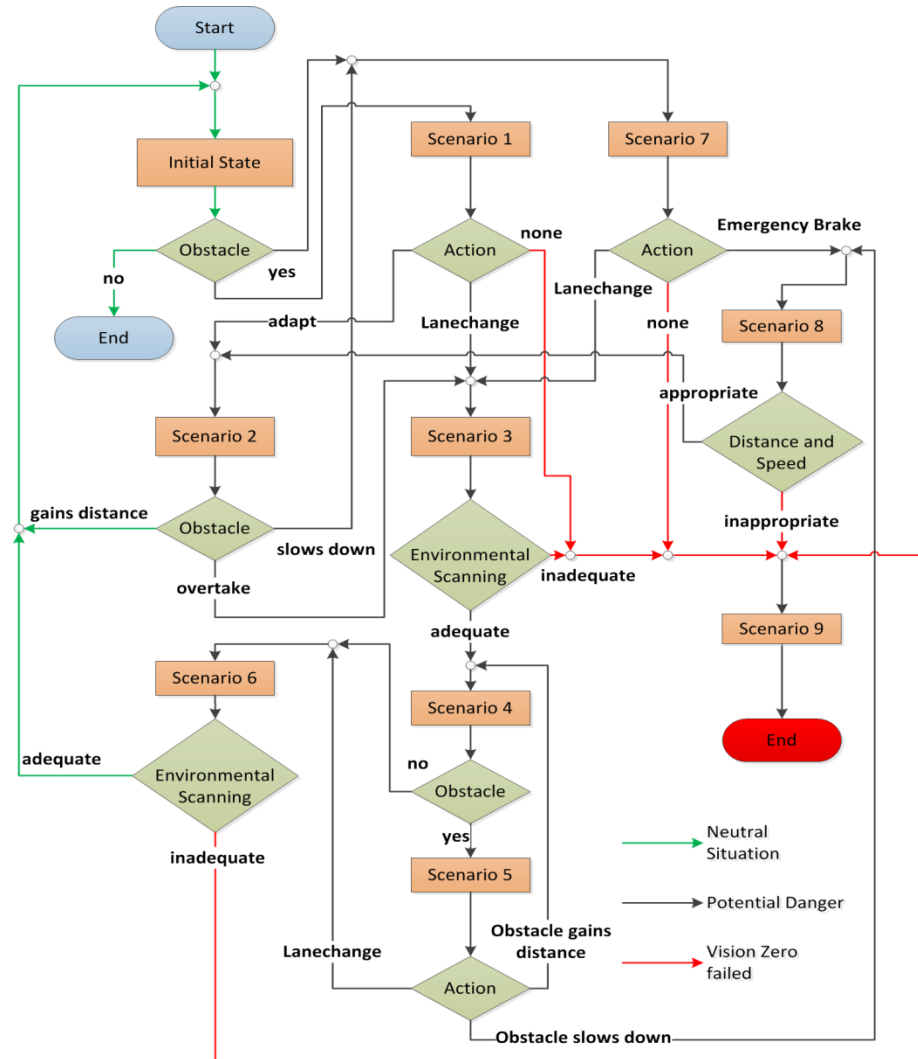
# Analysis of the situation (2)

## Flowchart by linking scenarios

- variation of the situation in order to identify critical paths
- 2 critical paths identified

Reasons:

1. insufficient environmental scanning
2. inappropriate driving behavior



# Evaluation: State of the art

May current vehicles with all conceivable Driver assistance systems and active safety functions fulfill the Vision Zero? (Best-Case Evaluation!)

Function	Sufficient environmental scanning	Appropriate driving behavior
Adaptive Cruise Control	<input checked="" type="checkbox"/> Range >250 m <input checked="" type="checkbox"/> Range detection	<input checked="" type="checkbox"/> Not ensured in all cases (demand for takeover) <input checked="" type="checkbox"/> Can be overruled by driver
Automatic emergency brake	<input checked="" type="checkbox"/> Range >250 m <input checked="" type="checkbox"/> Range detection	<input checked="" type="checkbox"/> Collision avoidance only in certain situations
Lane change assistant	<input checked="" type="checkbox"/> View field ahead is mostly not covered	<input checked="" type="checkbox"/> Only indicative, can be ignored by driver
Lane keeping assistant	<input checked="" type="checkbox"/> Distinguishable driving lanes are required	<input checked="" type="checkbox"/> Can be overruled by driver

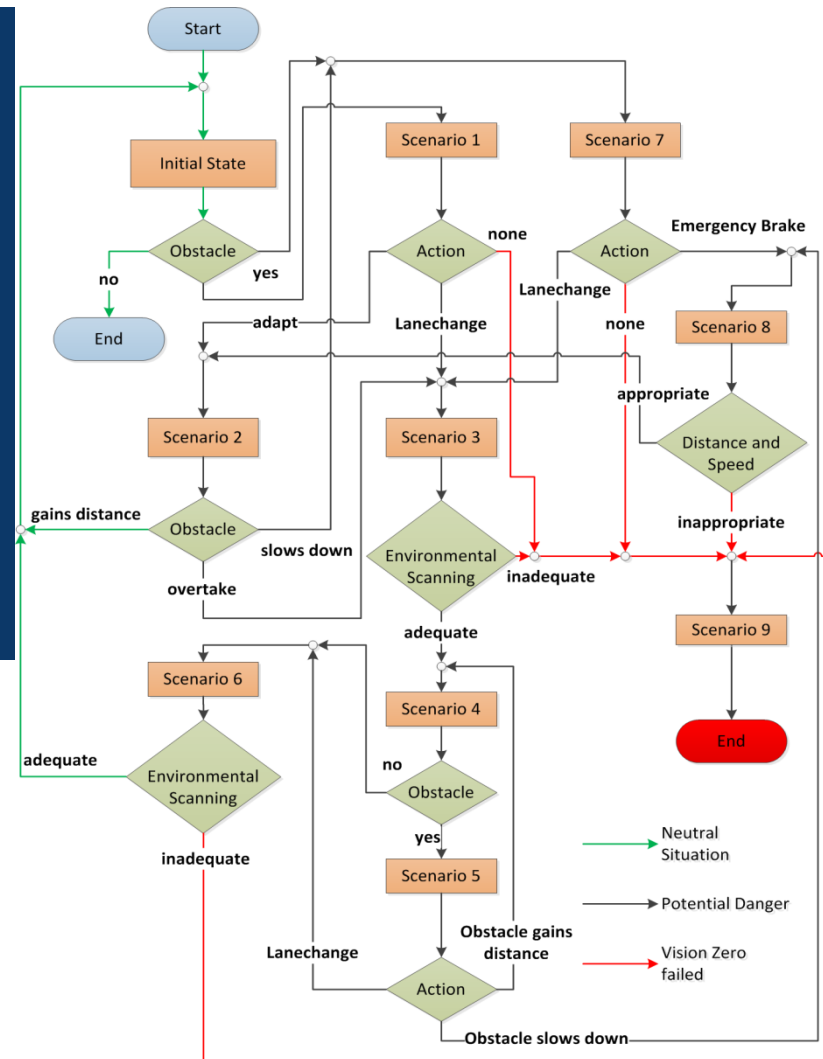
**Can the Vision Zero even be achieved in case of a fallible human driver?**

# Evaluation (4): Role of the human driver

## Fulfillment of Vision Zero with human drivers

- ✓ comprehensive skills to interpret complex traffic situations
- wide spreading due to mastering of the driver job
  - different competence of the drivers
  - health status of the drivers
  - comprehensive realtime analysis of the current driving ability hardly possible
- sudden occurrence of driving failures can never be excluded with 100 % certainty

**Conclusion:** without a high degree of automation in the vehicles the Vision Zero seems hardly realizable!





# Integral Safety Concept for Vision Zero

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- the degree of automation in vehicles has to be increased
- implementation of on-board diagnosis systems for ambient environment sensor data in realtime
- detection of all obstacles in the visual range of the respective sensors
- determination of relevant parameters affecting driving dynamics in real time (current friction coefficient)
- determination and automatic realization of appropriate driving behavior

# Outlook: Appropriate driving

Algorithm determining appropriate driving behavior in normal operating state of the vehicle

Current visual range

Current traffic situation

Properties of the vehicle

Properties of the road

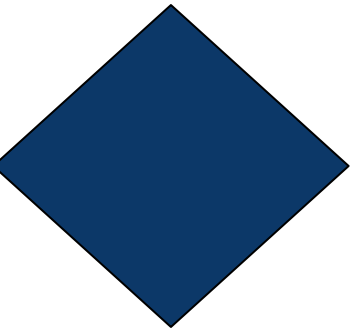
Traffic signs & hints

Available infrastructure

Maximal velocity

Minimal Curve radius

warning



Intervention in vehicle dynamics

# Conclusion

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- a systematic analysis of simple traffic situations leads to two main causes for accidents:
  - **Insufficient environmental scanning** and **inappropriate driving behavior**
- in most of the scenarios safety and driver assistance functions were already able to detect the hazardous situation
- but safety and driver assistance system can not compensate driving failures completely
- without a high degree of automation of the vehicles the fulfillment of Vision Zero seems unrealistic
- the determination and realization of an appropriate driving behavior is a key function for the achievement of Vision Zero in longitudinal traffic

# Thank you for attention

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# Outline

- Vision Zero
- Object of investigation
- Procedure model
- Analysis of the situation
- Evaluation
- Conclusion & outlook



ref.: wikipedia.de