



Verkehrsunfälle aus Traumabiomechanischer Sicht

Wolfram Hell

Institut für Rechtsmedizin, München

Präsident GMTTB e.V.

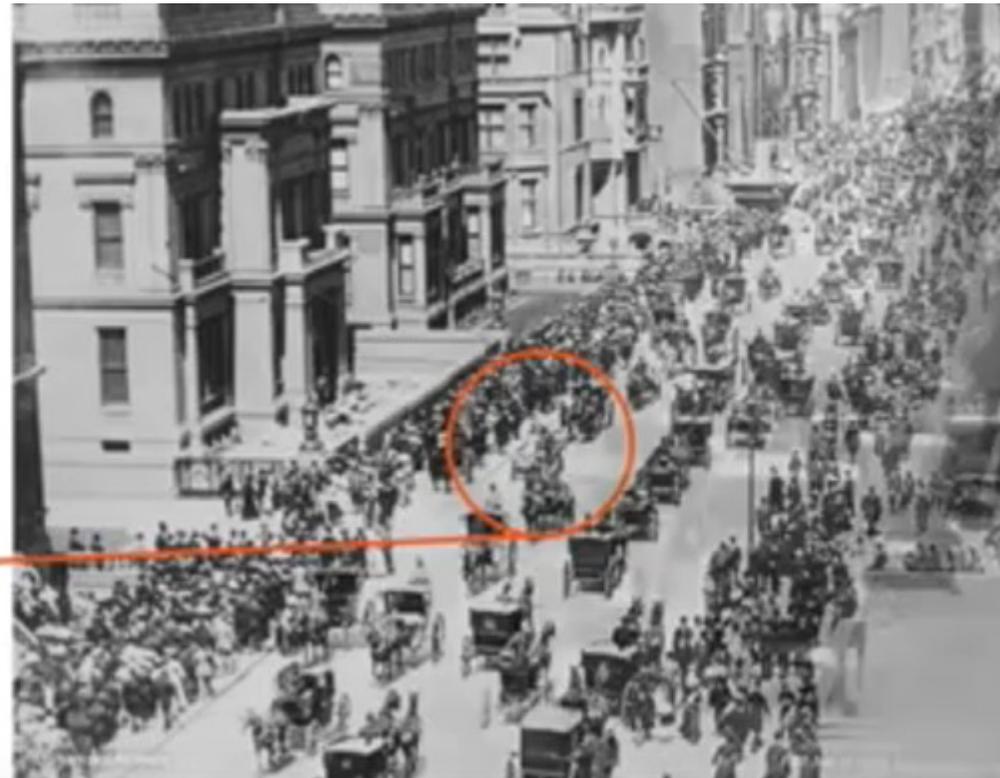
5th AVE NYC
1900



Copyright © 2016 Tony Seba

5th AVE NYC
1900

Where is
the
car?



Copyright © 2016 Tony Seba

5th AVE NYC
1913



Copyright © 2014 Tony Seba

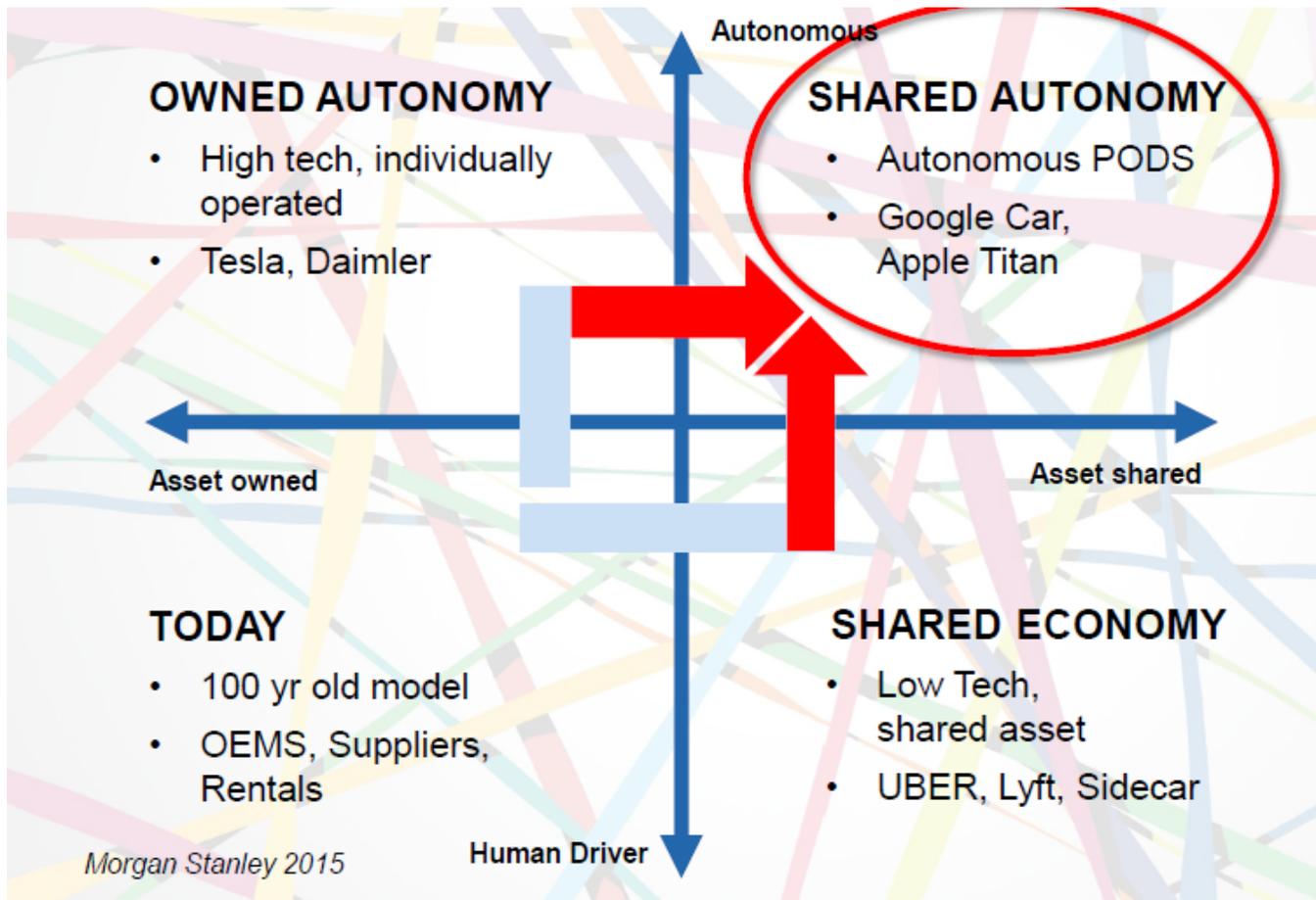
George Eastman Photo Collection

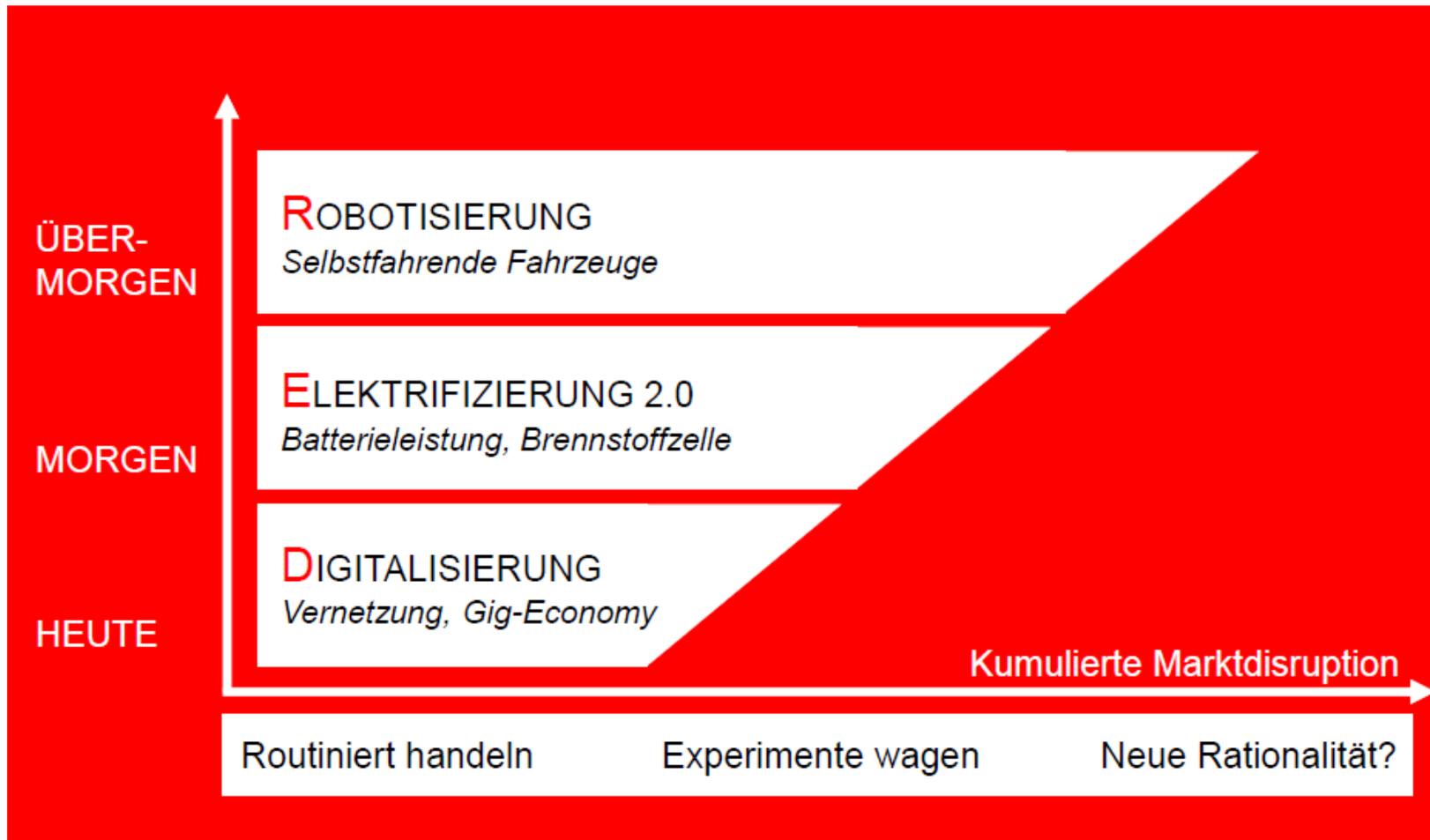
Photo: 7 June 1913, New York, Fifth Avenue looking north



Quelle: Tony Seba, Stanford Universität

Verkehr in Zukunft





Transformation zum Autonomen Fahren analog Motorisierung?



Vision 2015

A world of driverless cars
Fully autonomous vehicles are developing faster than anyone would have thought a few years ago, with many experts predicting that they will become widely available in the next 5–10 years. Many questions remain, but it is already possible to imagine how this new world of driverless cars will work.

PERCEPTION
Vehicles use **radar** to detect obstacles, a **laser ranging system** to map the surroundings in three dimensions, and **video cameras** to identify objects such as traffic lights, construction signs, pedestrians and other vehicles.

DECISION AND ACTION
To make the appropriate responses to rare events—such as a ball bouncing in from a playground, or a plastic bag blowing down the roadway—the cars rely on **algorithms** refined through millions of kilometres of test drives.

ADAPTIVE TRAFFIC FLOW
Smart Infrastructure integrates V2V signals from the moving cars to optimize speed limits, traffic-light timing and the number of lanes in each direction on the basis of the actual traffic load. The result is a smoother flow, shorter travel time and less energy wasted at traffic lights or in traffic jams.

ROUTE PLANNING
An **on-board computer** uses sensor data to plot a route that gets the car where it needs to go, while avoiding people, potholes and other vehicles.

LOCATION
Mapping software uses **global positioning system** data to tell the car where it is in relation to roads, traffic signals, and other landmarks.

COMMUNICATION
Vehicle-to-vehicle (**V2V**) radios send signals between cars, trucks and infrastructure items such as traffic lights.

ROAD TRAINS
Vehicles can take advantage of aerodynamics and save fuel by following one another almost bumper to bumper. They are protected from catastrophic pile-ups by their V2V radios, which allow all the cars in line to hit their brakes at the same time.

2020s
The decade when driverless cars are predicted to become widespread.

10%
Fuel savings for cars that travel in formation.

CITIES TRANSFORMED
MASS TRANSPORT People increasingly give up owning cars in favour of calling companies to pick them up wherever they are and drop them off wherever they need to go—a driverless version of a ride-sharing service.
LAND USE Urban centres begin to undo the many accommodations they have made for personal vehicles—starting with the vast quantities of real estate devoted to parking, which could be adapted to more productive uses.

800 million
One estimate of the number of US parking spaces. Many could be used for other purposes if people ride-share more.

ILLUSTRATION BY IAN FOLEY, TEXT BY M. MITCHELL WADE/ROIP, DESIGN BY KELLY BRADSE

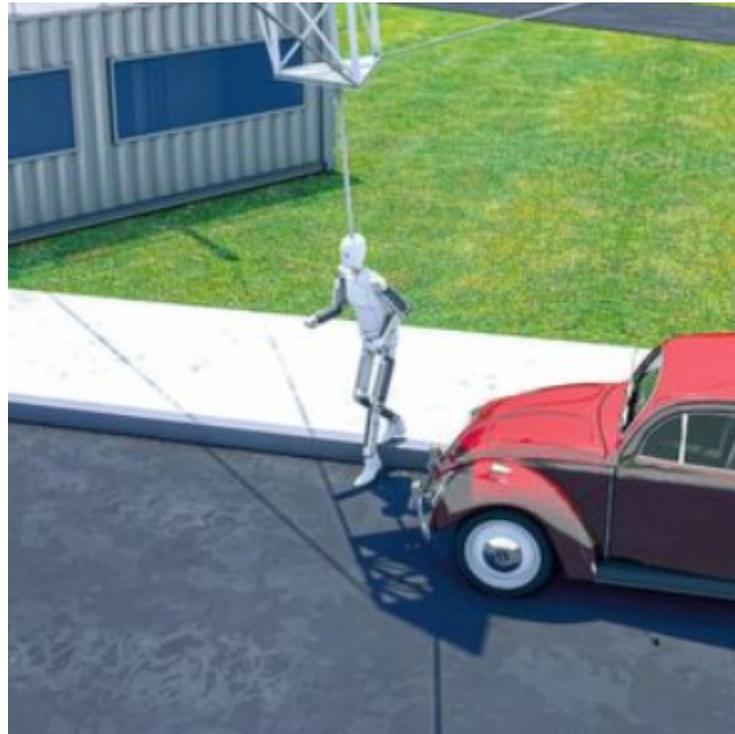
© 2015 Macmillan Publishers Limited. All rights reserved.

Senioren als Fussgänger



Source: USA - Digges 2001

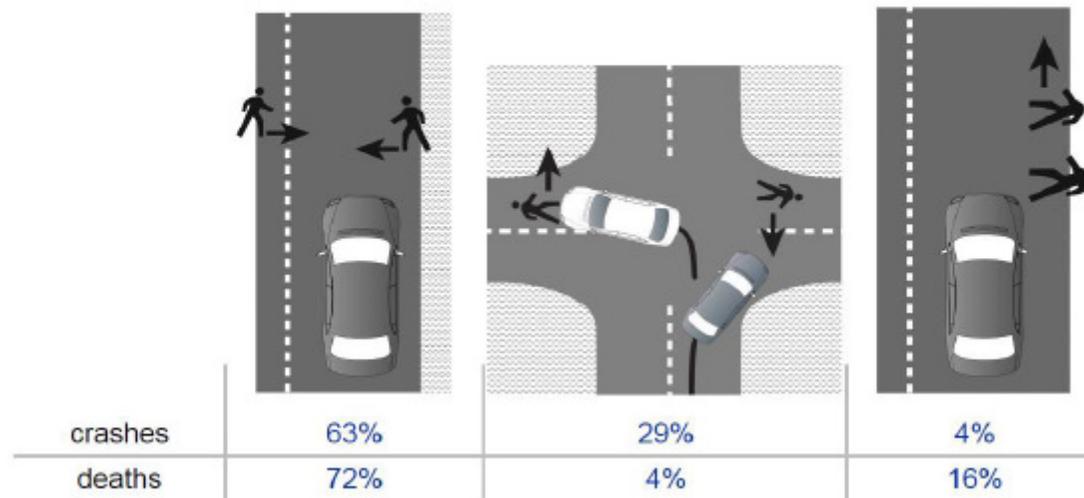
Active Safety Testing



IIHS USA

Vehicle and pedestrian movement

Single-vehicle pedestrian crashes, front of passenger vehicle

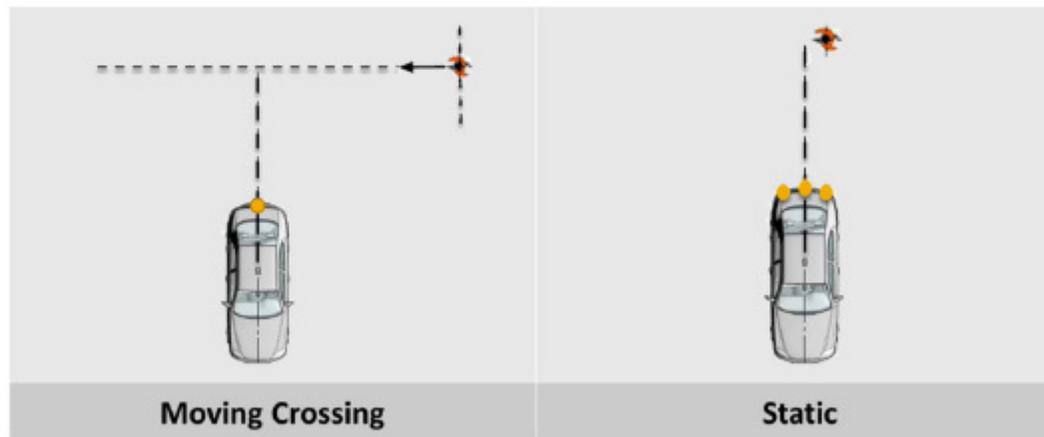


Euro NCAP Fussgänger Tests II

VRU scenarios for AEB in 2020

PraxisConference
Autonomous Emergency
Braking and Steering

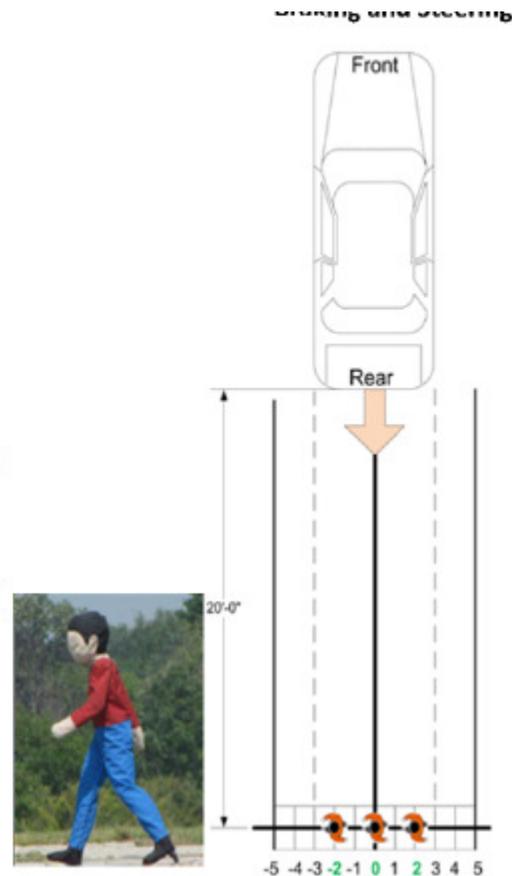
- AEB Pedestrian Reverse



US NCAP 2019

- **Rear Automatic Braking**

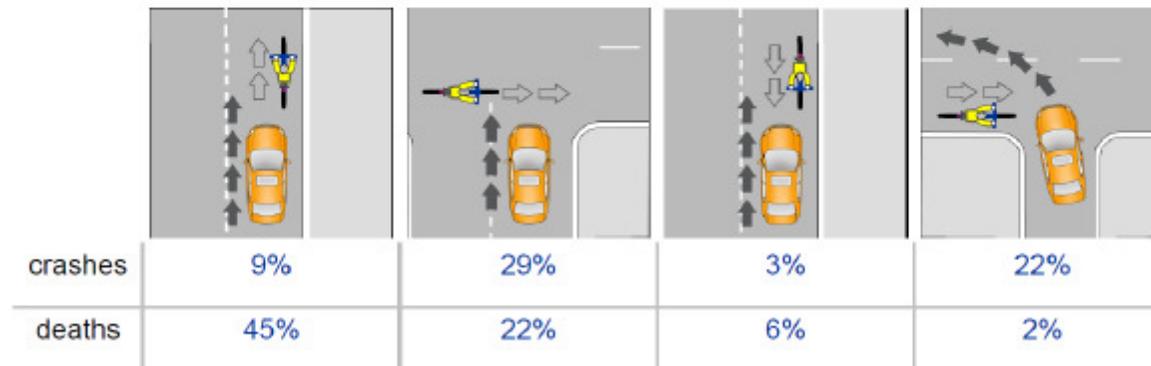
- Test procedure: REAR AUTOMATIC BRAKING FEATURE CONFIRMATION TEST, December 2015
- Test object: 4active Systems Euro NCAP pedestrian child pose-able and/or articulated mannequin (46.5 inch height, simulating a 6-year-old child)
- 3 positions: 2 / 0 / -2 inches from the centreline @ 20 ft from vehicle rear
- Pass if vehicle comes to a stop before it reaches the location of the test object and with no physical contact with the test object for each of the three test object locations assessed.



IIHS USA

Vehicle and cyclist pre-crash movement scenarios

Most likely to result in death of cyclist



US NACP Plan 2019

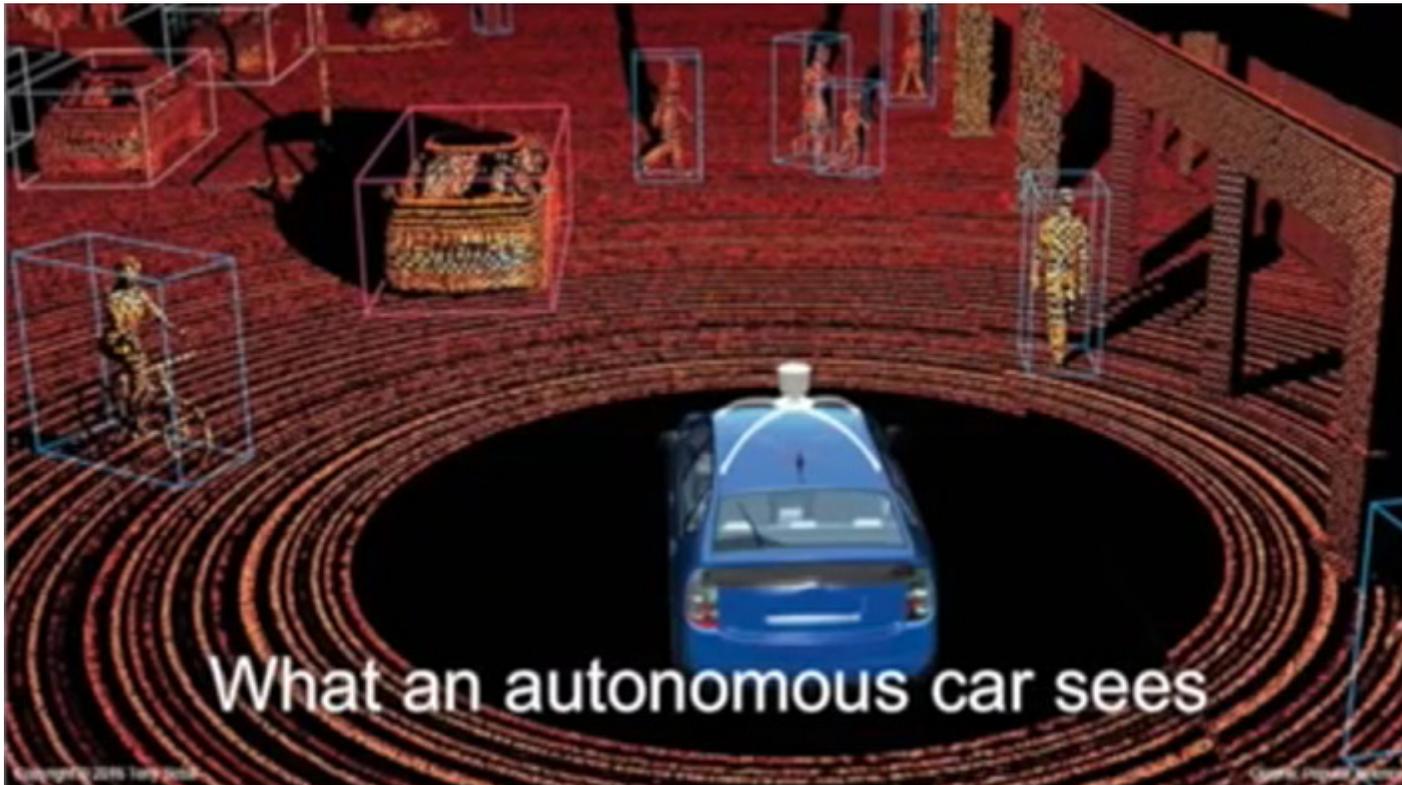
stopped?



- **1 - 5 Stars**
- **Half stars for better discrimination**

Autonomes Fahren DIE Lösung?





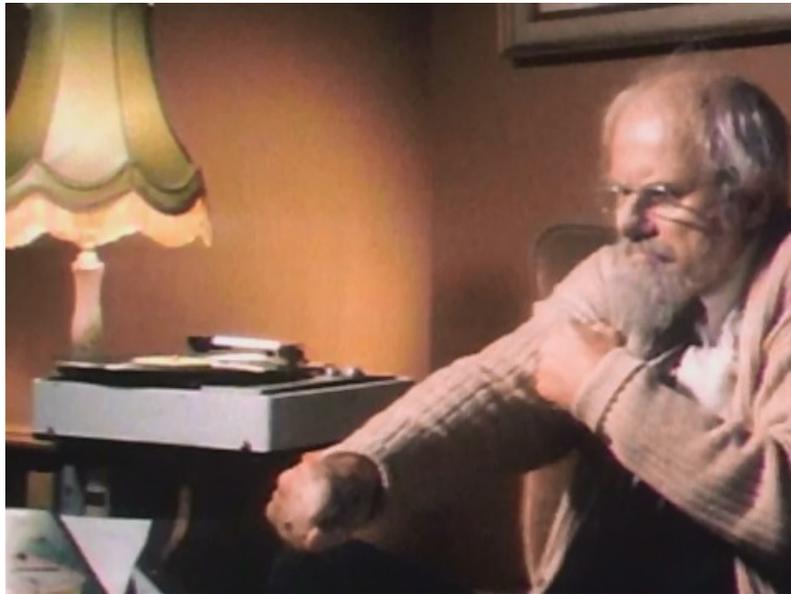
Akzeptanz für autonomes Fahren

Japan 28%

Germany 37%



Probleme Ergonomie Umgang mit neuer Technik



Level 2 BMW X 5 Mod. 2019

STATE OF THE ART. BMW'S BRAND NEW X5.
LEVEL 2.



Steering and lane control assistant

Priority warning and wrong way warning

Automatic speed limit assistant

Active cruise control with Stop&Go function

Emergency stop assistant

Assisted Driving Plus

HUD

Crossing traffic warning

Steering assistant

Ultrasonic sensors

Surround View

Panorama View

Top View

3D View

Reversing assistant

Side collision protection

Rear view camera

Evasion aid

Lane keeping assistant with active side collision protection

Lane departure warning

Lane change assistant

Lane change warning

Parking assistant plus
automated longitudinal and lateral parking guidance

Remote 3D View

Traffic jam assistant

Vision Zero = keine Verkehrstoten



Examples of Vision Zero rhetoric

Go upstream instead of downstream

What is an acceptable number of deaths?

Is there anyone in the room that has never made a mistake?

Have you tried to drive on a bridge 50 meters up, 3 meters wide and without any guardrails in 100 km/h?

In the dark? In the rain? With only one hand on the steering wheel?

2016 MUARC - TAC
Road Safety Seminar

INNOVATIVE THINKING IN REDUCING ROAD TRAUMA

TRAFIKVER
SWEDISH TRAFFIC

Professor Claes Tingvall

MONASH University
Innovative thinking in reducing road trauma

The slide features a photograph of a red car driving on a narrow, winding road through a mountainous landscape. The car is positioned on the left side of the road, with a steep cliff on the right. The background shows a valley with a river and more mountains under a clear sky. The slide also includes logos for Monash University, TAC, and Trafikverket (Swedish Transport Agency).

Vision Zero

- Ethische Plattform
- Es kann nicht akzeptiert werden dass Menschen im Transportsystem getötet oder schwerverletzt werden
- Seit 1997 wird JEDER TÖDLICHE Unfall in Schweden analysiert, Gegenmaßnahmen vorgeschlagen und nach 6 Monaten überprüft ob etwas passiert Mensch – Fahrzeug - Umfeld



Claes Tingvall



ACCIDENT ANALYSIS

William Haddon Matrix



- Strassendesign muss eingebunden werden

Vision Zero a policy innovation

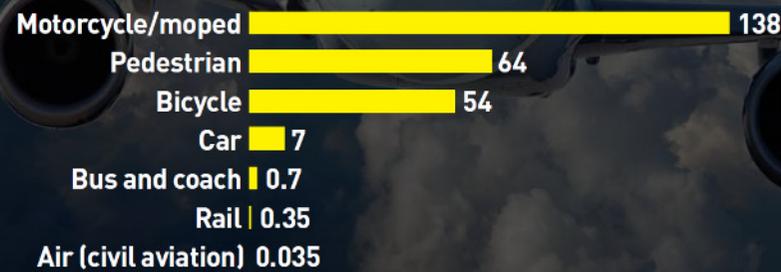
	Traditional	Vision Zero
What is the problem?	Accidents risk	Fatalities and serious injuries
What causes the problem?	Human factors	Humans make mistakes Humans are fragile
Responsibility?	Individual road users	System designers
Peoples demand for road safety?	People don't want safety	People want safety
What is the appropriate goal?	Optimum number of fatalities and serious injuries	Eliminate fatalities and serious injuries



**Would you fly if it was as dangerous
as traveling on the road?**



Deaths in the EU per 1000 million person kilometres (2001–2002):



Source: The Swedish Road Administration



(Tingvall...)

- Most countries in the developed part of the world have adopted Vision Zero (UN, USA, EU, Australia, NZ etc)
- Most car manufacturer and suppliers have adopted something similar (Volvo, Mercedes, Toyota, Autoliv etc)
- Most car manufacturers and suppliers have developed technology beyond imagination

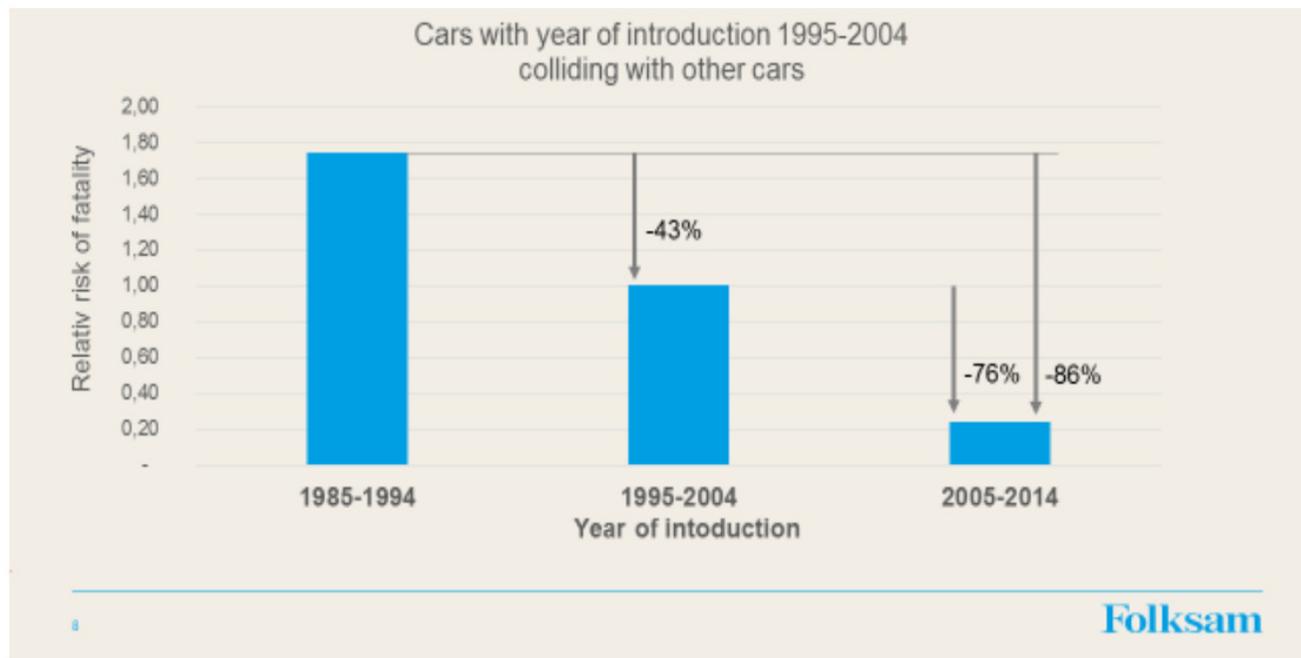
- But!

Current Traffic Safety Situation



- Few countries, few cities and few manufacturers have a robust plan to deliver a safe road transport system!
- Few countries, few cities and few manufacturers does not even have a firm plan or idea to improve the current situation

Development in risk of fatality



Clear results



Better results than reduction
of heart attacks
during the same period

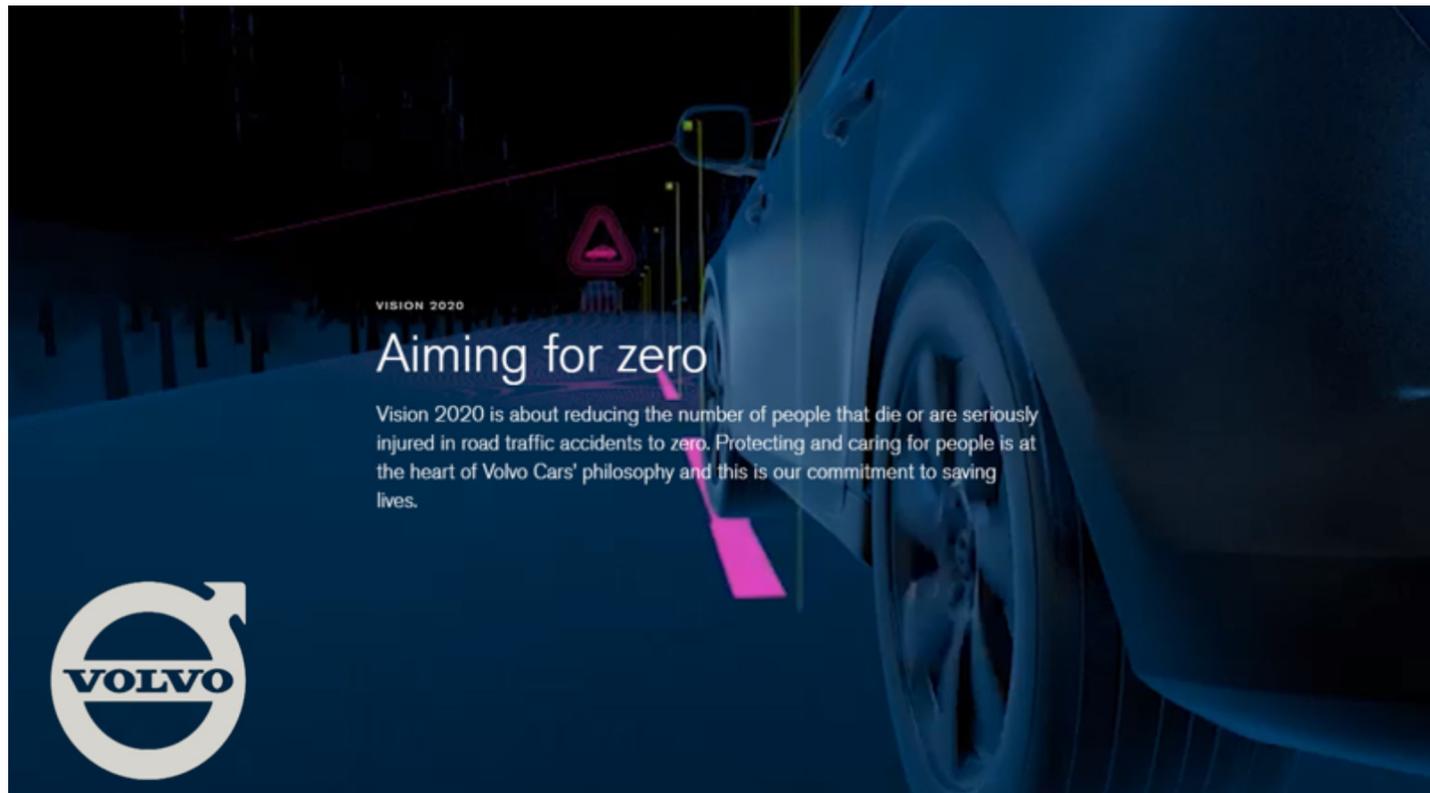
**2/3 of the reduction in deaths
comes from replacement of the car fleet**

Safe crash barrier?



LMU

LUDWIG-
MAXIMILIANS-
UNIVERSITÄT
MÜNCHEN

The image is a promotional graphic for Volvo's Vision 2020. It features a dark, blue-tinted background showing the side profile of a car. A red laser line is projected from the front of the car towards a triangular warning sign on a road in the distance. The text "VISION 2020" is written in small white letters above the main title "Aiming for zero". Below the title, a paragraph explains the vision: "Vision 2020 is about reducing the number of people that die or are seriously injured in road traffic accidents to zero. Protecting and caring for people is at the heart of Volvo Cars' philosophy and this is our commitment to saving lives." The Volvo logo, a white circle with an arrow and the word "VOLVO" inside, is positioned in the bottom left corner.

VISION 2020

Aiming for zero

Vision 2020 is about reducing the number of people that die or are seriously injured in road traffic accidents to zero. Protecting and caring for people is at the heart of Volvo Cars' philosophy and this is our commitment to saving lives.



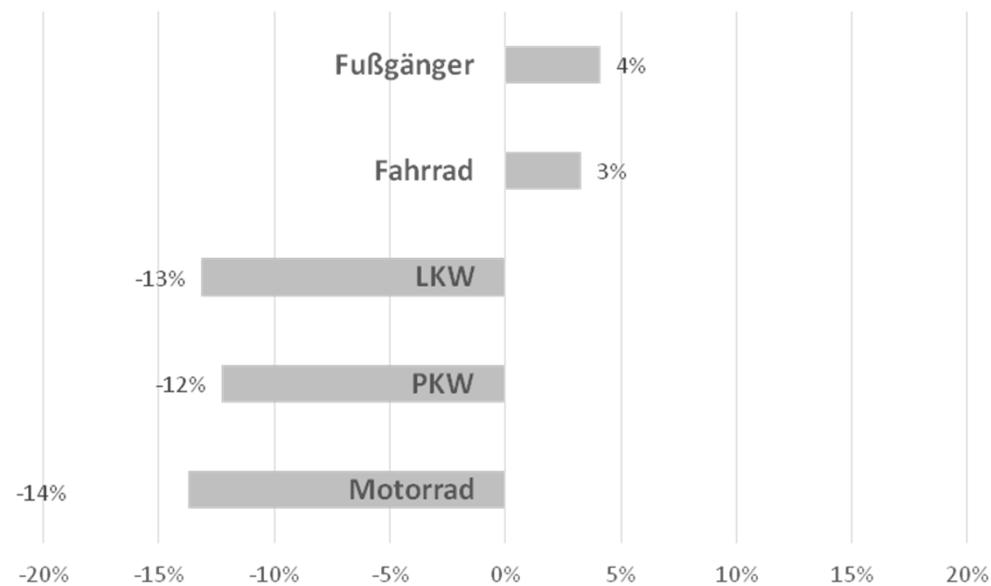
Joint effort to define boundary conditions

			Passive	Active
80		Head-on	60	20
40		Pedestrians	10	30
70		Side	55	15
△ 40		Rear-end	△ 20	△ 20
110		Large animals	80	30

Deutschland Trend Verkehrstote



Entwicklung Getötete 2010-2016

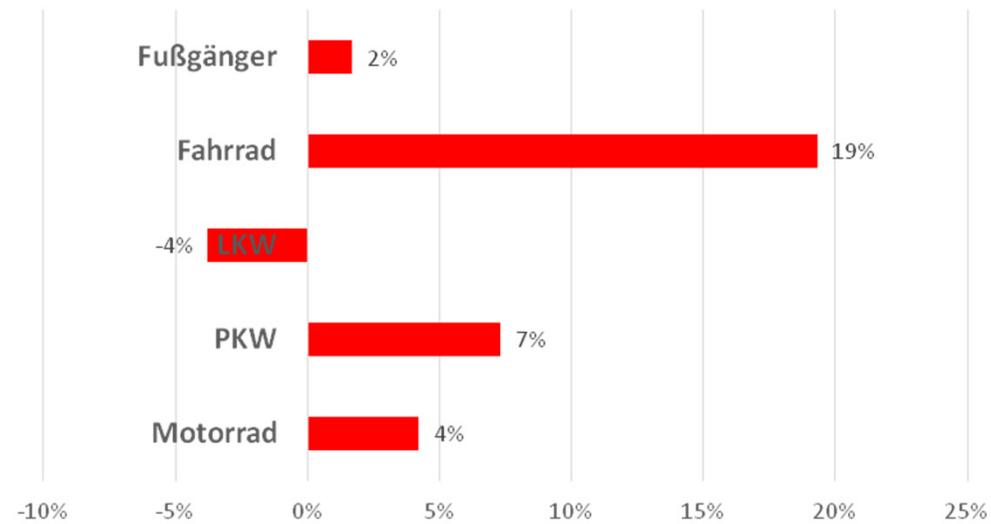


Deutschland

Trend Schwerverletzte



Entwicklung Schwerverletzte 2010-2016



⑩ Damit im Jahr 2014 im Schnitt **neun Menschen pro Tag** bei Unfällen ums Leben gekommen.

⑩ Verkehrstote 2014 Deutschland

⑩ 9/Tag

⑩ 278/Monat



⑩ **Verletzte ca. 389.000**

⑩ Ca. **67.700 Schwerverletzte** davon ca. **17.000 Schwerstverletzte** in Deutschland/Jahr

⑩ 185/Tag

⑩ 5.500/Monat

47/Tag

1.400 Monat

⑩





EU 2017

OVERVIEW-MAJOR ISSUES

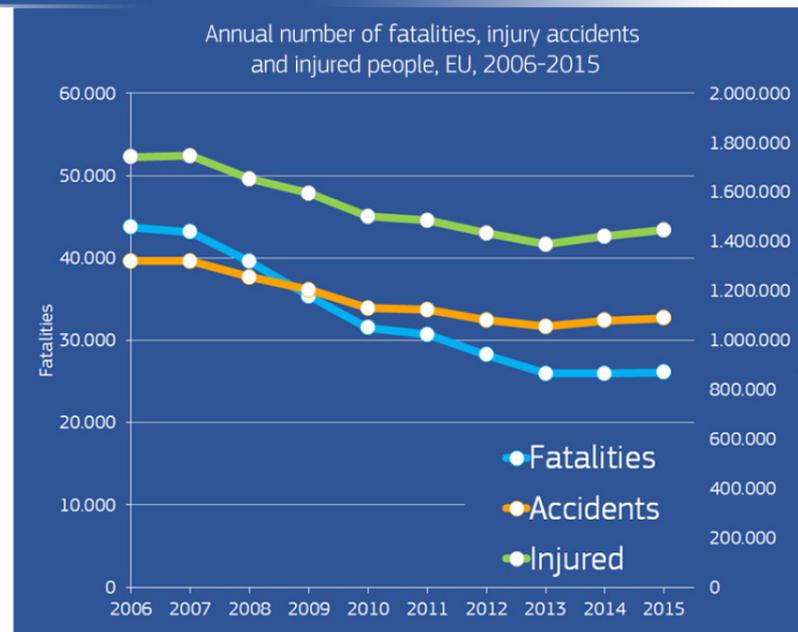


1 Million

Road Accidents per Year -
2.900 per day (2015)
with consequences:

1,4 Million Injured
(3.600 per day)

26.100 Fatalities
(70 per day)

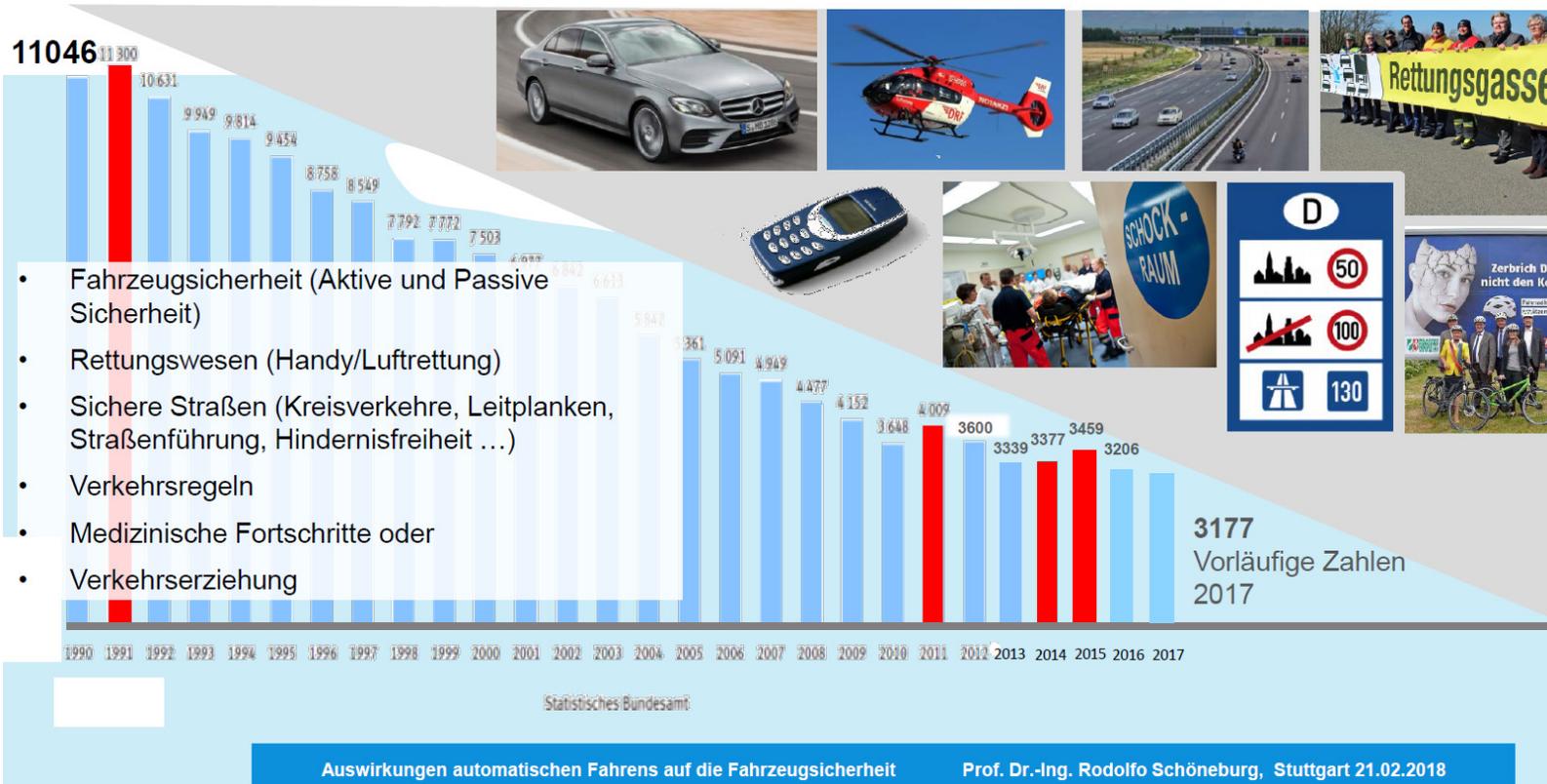


On German roads nearly
780,000 people have died
in traffic accidents since
1950.

The number of injured
exceeds 31 million.

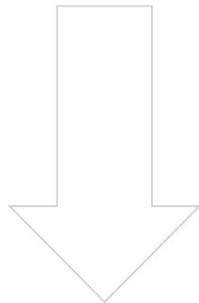
Berlin declaration of Traffic Safety

VDI Prof. Schöneburg



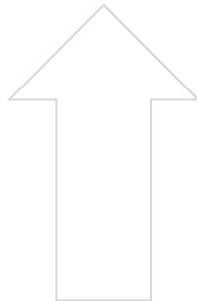
Going downstream

(OR SIMPLY FINDING THE VICTIM)

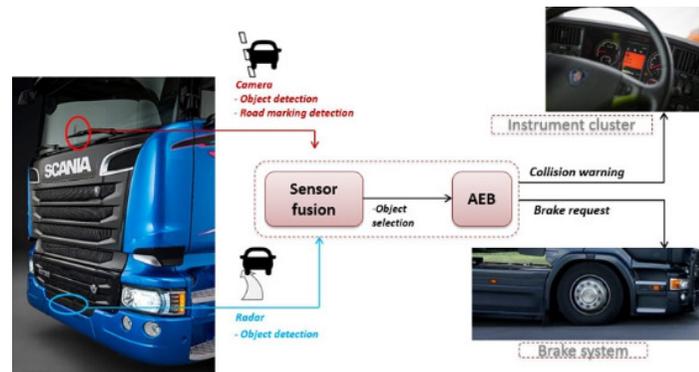


Going upstream

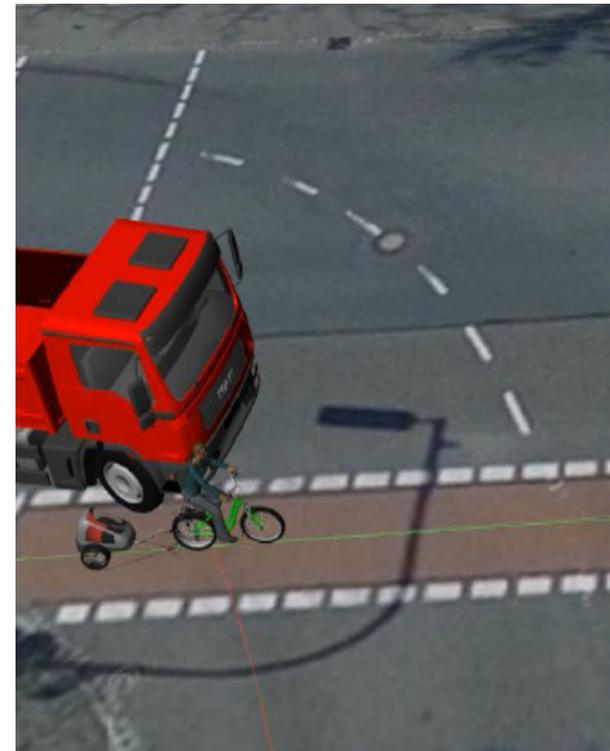
(OR SIMPLY FINDING THE SYSTEMIC PREVENTION)



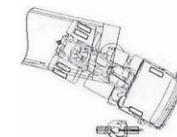
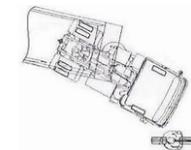
Truck emergency braking to zero



TRUCK: Blindspot detection system for bicyclists and pedestrians



immer wieder gleiches Unfallmuster
gerader Radweg + grüne Ampel



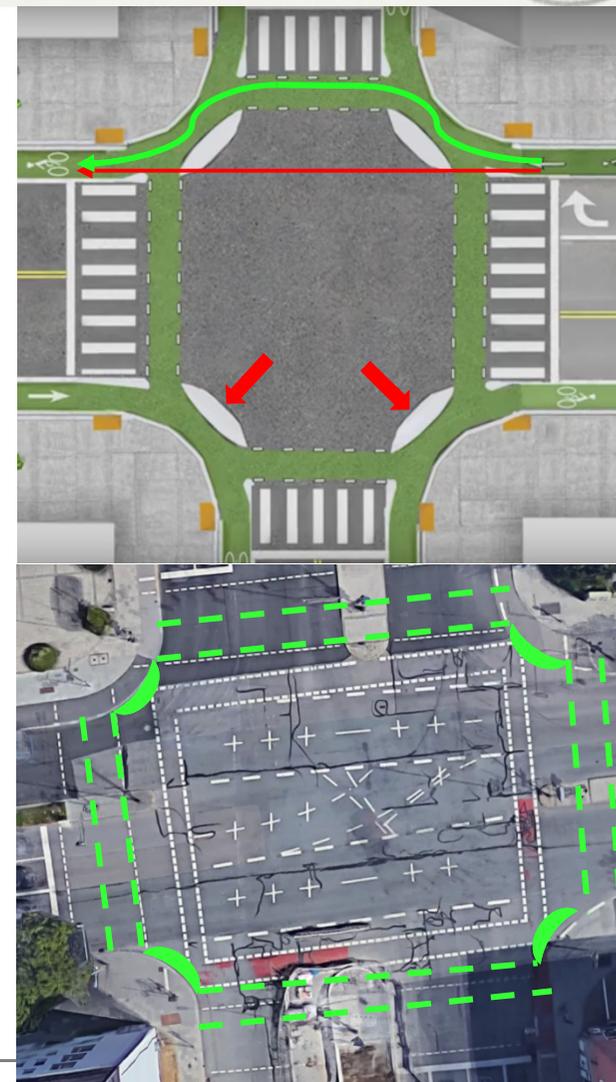
word datei ->

Präventionsmaßnahmen

Fahrradunfälle

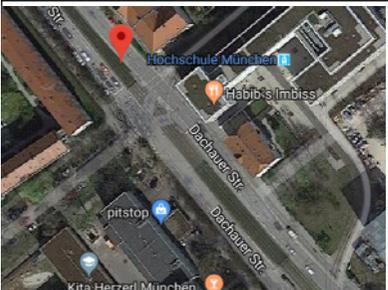
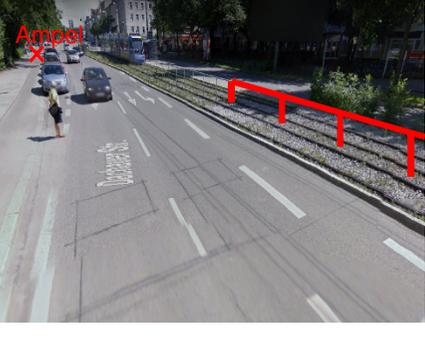
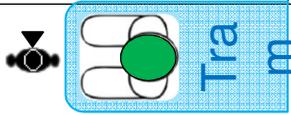


- Optimierung von Kreuzungen
- Bordsteinkante abrunden
- Cycle Highway
- Verbesserte Ampelschaltung



Fall 1586

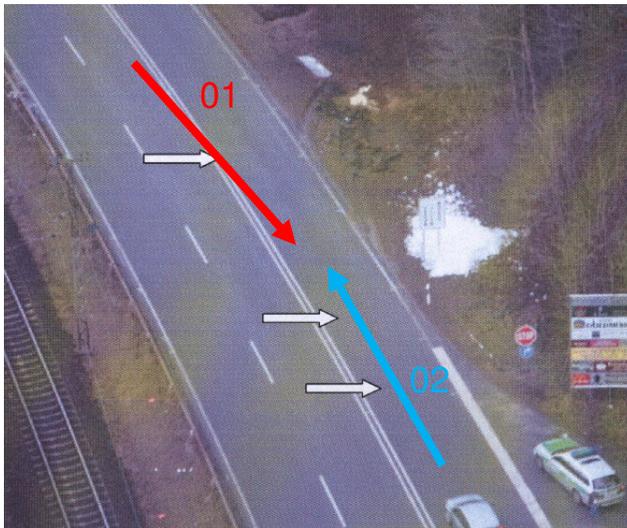
FG-Tram

Nummer: 1586	Ort: München, Dachauer Straße		
	Unfallbeteiligte und Umweltfaktoren: <ol style="list-style-type: none"> ① Fußgänger: m, 94, getötet ② Straßenbahn: Fahrer: m, 51, unverletzt 		
Fallbeschreibung: FG 01 (m, 94, 100% schwerbeschädigt z. B. keinerlei Hörvermögen mehr außerdem dement) wollte innerorts eine stark befahrene Straße mit zwei bis drei Fahrspuren pro Fahrtrichtungsseite überqueren. Die beiden Fahrbahnen mit den unterschiedlichen Fahrtrichtungen werden an der Unfallstelle durch zwei Tramgleise, welche zwischen den Fahrbahnen verläuft, abgegrenzt. FG 01 hatte bereits die Fahrspuren der ersten Fahrtrichtungsseite passiert und stand dann wenige cm rechts neben dem Gleiskörper. Die zu diesem Zeitpunkt auf dem rechten Gleis fahrende Tram 02 (Trambahn, m, 51) leitete sofort eine Gefahrenbremsung ein konnte einen Zusammenstoß mit der rechten Fahrzeugseite gegen den linken Schulterbereich des 01 nicht mehr verhindern. Die Tram kam wenige Meter nach dem Zusammenstoß zum Stehen. 01 stürzte nach rechts auf den Gleiskörper und wurde schwerverletzt ins KH verbracht. Dort verstarb 01 drei Tage später.			
Auffälligkeiten: -Starke körperliche Einschränkung des FG		Verbesserungen: -Geländer	

Example Opposite Traffic 2+1 country road



- Mid-barrier would have prevented most severe accident consequences





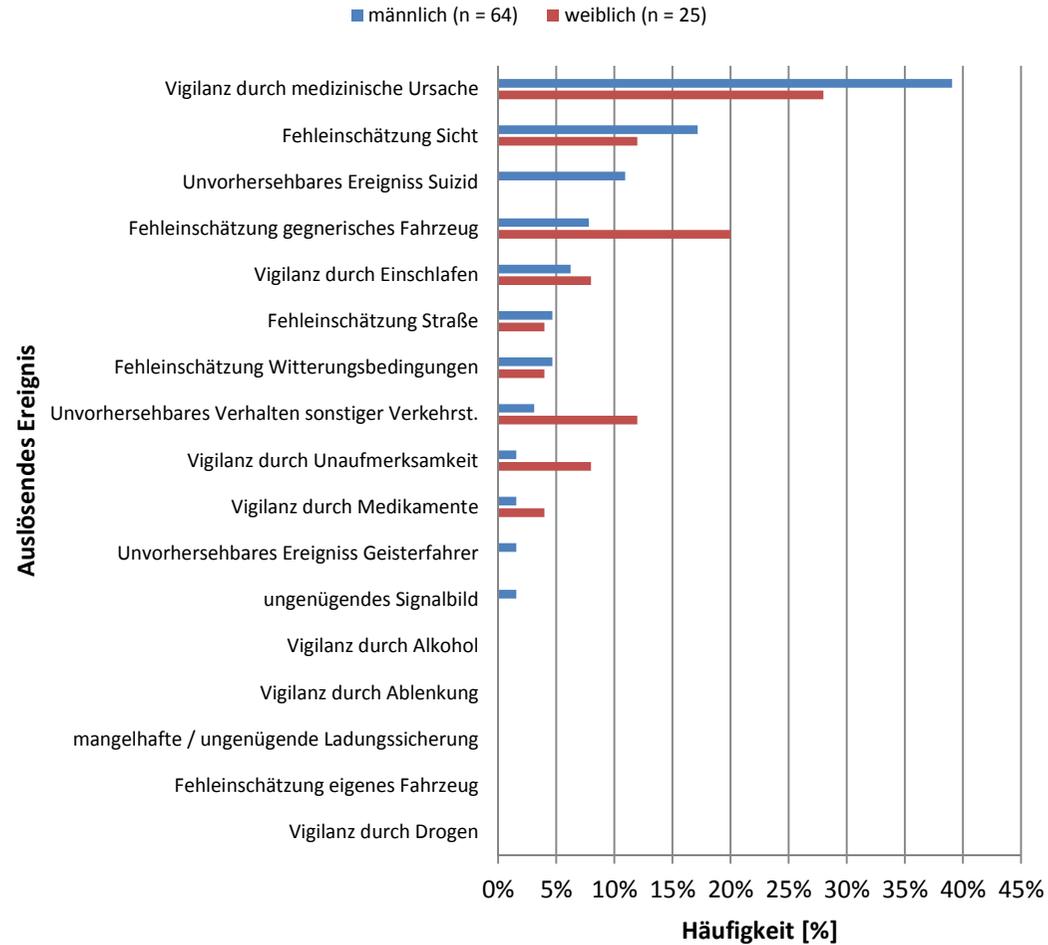
2+1 roads

- First built in 1998
- Now 2000 km
- Up to 90% reduction in fatalities
- Production cost 200-300 US\$/m
- Popular among road users



Analyse der Sicherheitsunfalldatenbank – Senioren > 65 J 2004-5 PKW

Auslösendes Ereignis bei Unfällen mit Senioren als Verursacher



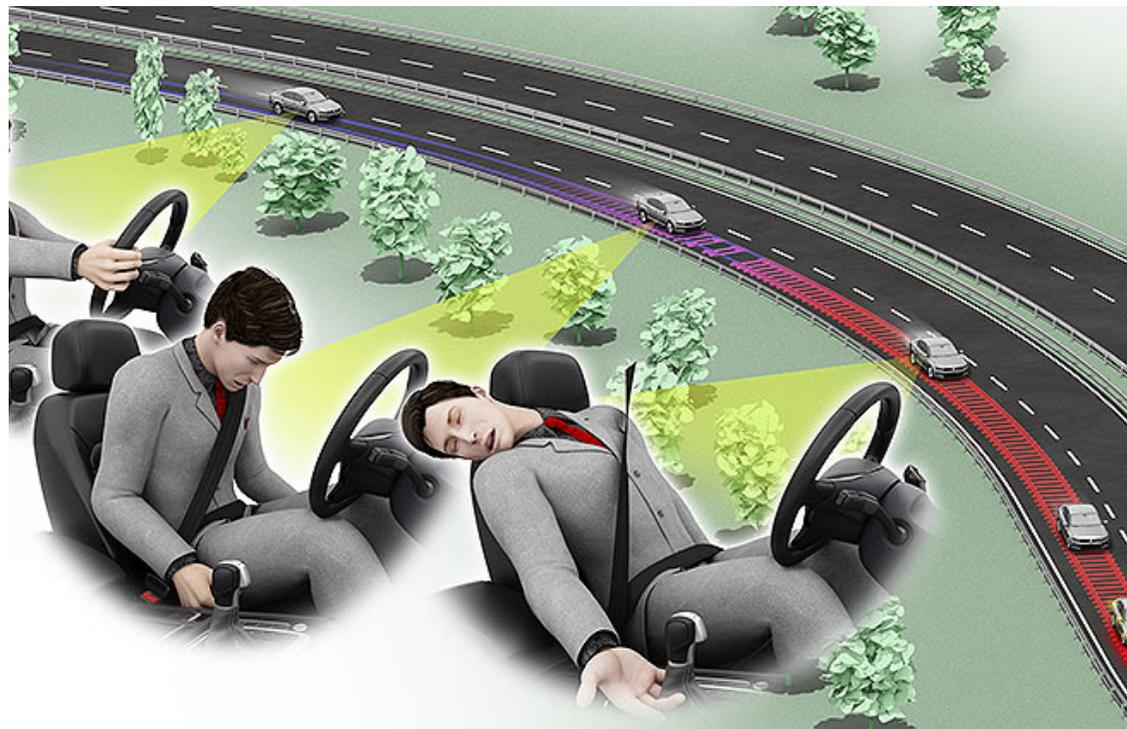
Realunfälle

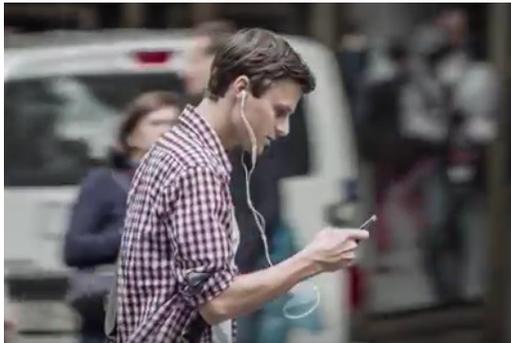
Vigilanz durch medizinische Ursache

		 weiblich, 64	Pkw-Fahrer 2 (*) erleidet Bewusstseinsstörung an Ampel und beschleunigt den Pkw unkontrolliert. Fußgängerin 1 (*) wird von Pkw erfasst und gegen Hauswand gedrückt. Bauchortenaneurysma. Mercedes-Benz SLK200	
		 männlich, 68		
		 männlich, 78	Pkw-Fahrer (*) fährt zunächst Schlangenlinien, kommt von Straße ab und prallt frontal gegen Baum. Unter Umständen Herzinfarkt bei bekannter Hypertonie. Mercedes-Benz 190 E 2.0	
				
		 männlich, 69	Pkw-Fahrer 1 (*) gerät auf Gegenfahrbahn kollidiert mehrmals mit Leitplanke und erfasst Lkw 2 frontal. Pkw 1 kollidiert zudem mit Fahrradfahrerin frontal, weiblich 53 schwerverletzt. Erhebliche Vergrößerung und Ausweitung des Herzens. Grobfleckige Vernarbung des Herzens. VW Golf IV	
		 männlich, 52		
		 weiblich, 74	Pkw-Fahrerin (*) kommt in Eichenallee von Straße ab und kollidiert frontal mit Baum. Beifahrerin schwer verletzt. Laut Beifahrerin erlitt die Fahrerin bereits früher Bewusstseinsstörungen. VW Polo	
				

Emergency assist VW (schon auf dem Markt)

Der rettet im Notfall: Wenn der Fahrer nicht mehr lenkt, beschleunigt oder bremst, sei es durch Schwindel, Schlaf oder Herzinfarkt, tritt der Notfall ein. Der Helfer hält dann das Fahrzeug sicher in der Spur und kann einen Auffahrunfall verhindern. Er schaltet die Warnblinkanlage ein, verringert die Geschwindigkeit und bringt den Wagen schließlich im eigenen Fahrstreifen zum Stillstand.





- ⑩ Mehr interdisziplinäre Zusammenarbeit
und Dialog
Unfallforschung, Fahrzeugindustrie, Strassenbau,
Politik
- ⑩ Kontinuierliches Monitoring einer relevanten
Stichprobe von Verkehrsunfällen mit Getöteten
- ⑩ Einfache und Kostengünstige Maßnahmen zuerst



Gesellschaft für Technische
und Medizinische Biomechanik e.V.



Konstanzer Konsens 2016 Reduktion von Verkehrstoten



Notwendige Massnahmen

Fussgänger

Tempo 30 Zonen, Nachtsichtbänder, Architektur

Fahrradfahrer, e-bikes

Fahradhelmquote steigern und Pflicht für e-bikes, Beleuchtung

Landstrassen

Fahrbahntrennung, mehr 2+1, Entschärfung von Bäumen, keine NEUEN Bäume pflanzen, Tempo 80

Pkw

Rollover Airbag/Gurt Sensor! Gurte hinten verbessern

LKW

Totwinkelerkennungssysteme (Kamera) vorschreiben



Notwendige Massnahmen

Motorrad

bessere Helme, Schräglagentraining

Strassenbau

Leitplanken/Cables zur Trennung
abgeflachte Bordsteine für Fahrradfahrer

Rumble Stripes

rechtsabb. Lkw Prophylaxe (Inseln vor Lkw)

Smombie

Aufklärung, Kontrolle und Sanktionen

Unfalldokumentation

Event Data Recorder EDR (blackbox) in allen Fahrzeugen

Klein Lkw < 12 t

Notbremssysteme



SAVE THE DATE

11. – 12. April 2019
9. GMTTB Jahrestagung
Hochschule Konstanz

20 Jahre Vision Zero

Sicht aus Medizin, Traumabiomechanik,
Fahrzeugindustrie, Verkehrsplanung,
Verbände, Politik und Behörden
Deutschland – Österreich – Schweiz

Keynote: Prof. Claes Tingvall, Schweden

GMTTB
Gesellschaft für Medizinische und
Technische Trauma-Biomechanik e.V.

Der menschliche Körper ist zerbrechlich



- Herzlichen Dank für die Aufmerksamkeit

VISION ZERO.
KEINER KOMMT UM. ALLE KOMMEN AN.

