12th Japan ITS Promotion Forum

Automated Driving System

Impact Assessment

(Traffic Accident Reduction)

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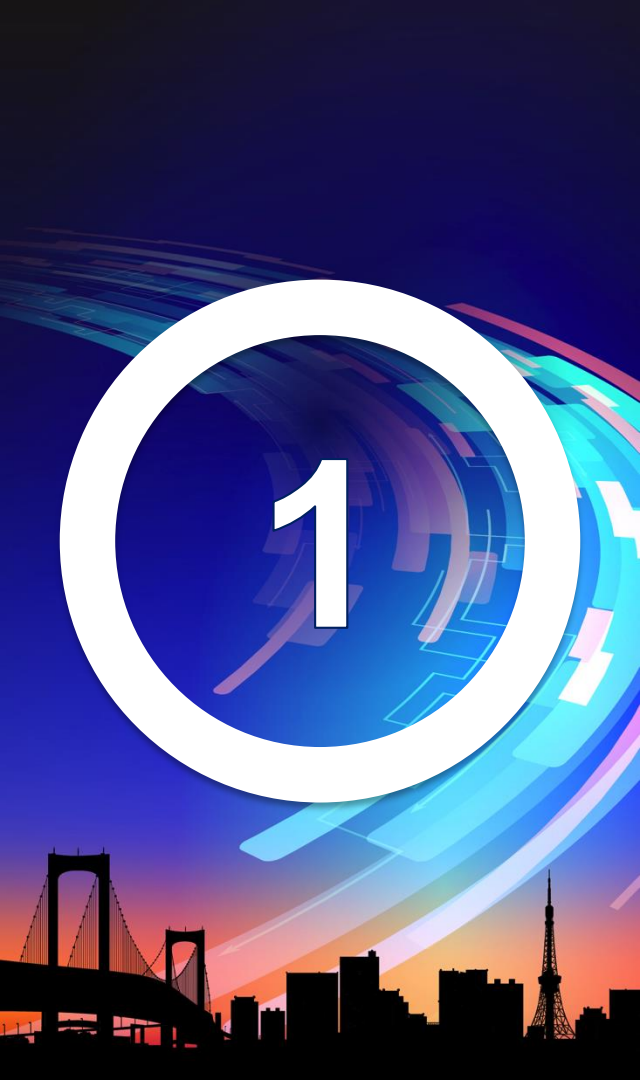
<Translated Version>

1. International cooperation activities (Trilateral “Impact Assessment” SG)
2. Research activity of safety impact assessment (EU “AdaptiVe” project)
3. Simulation development at SIP-adus (Estimation of detailed effects of traffic accident reduction)

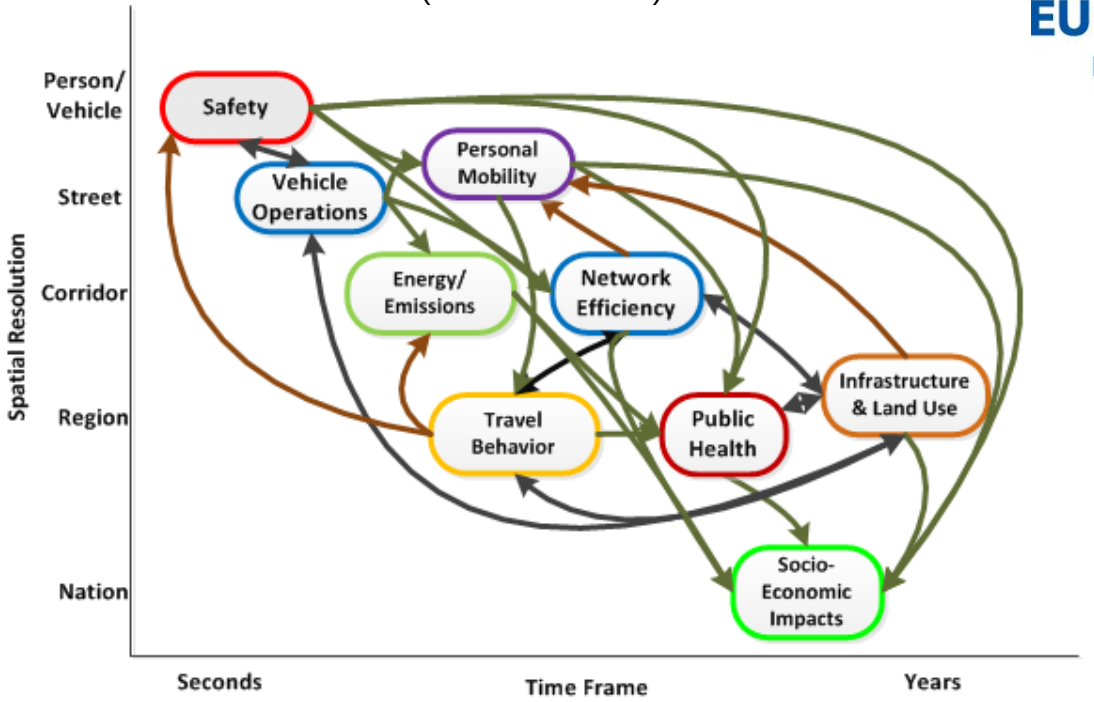


International cooperation activities

(Trilateral “Impact Assessment” SG)

Activities of Trilateral "Impact Assessment" Study Group

Areas of impact from automation of road traffic
(Source: US DOT)



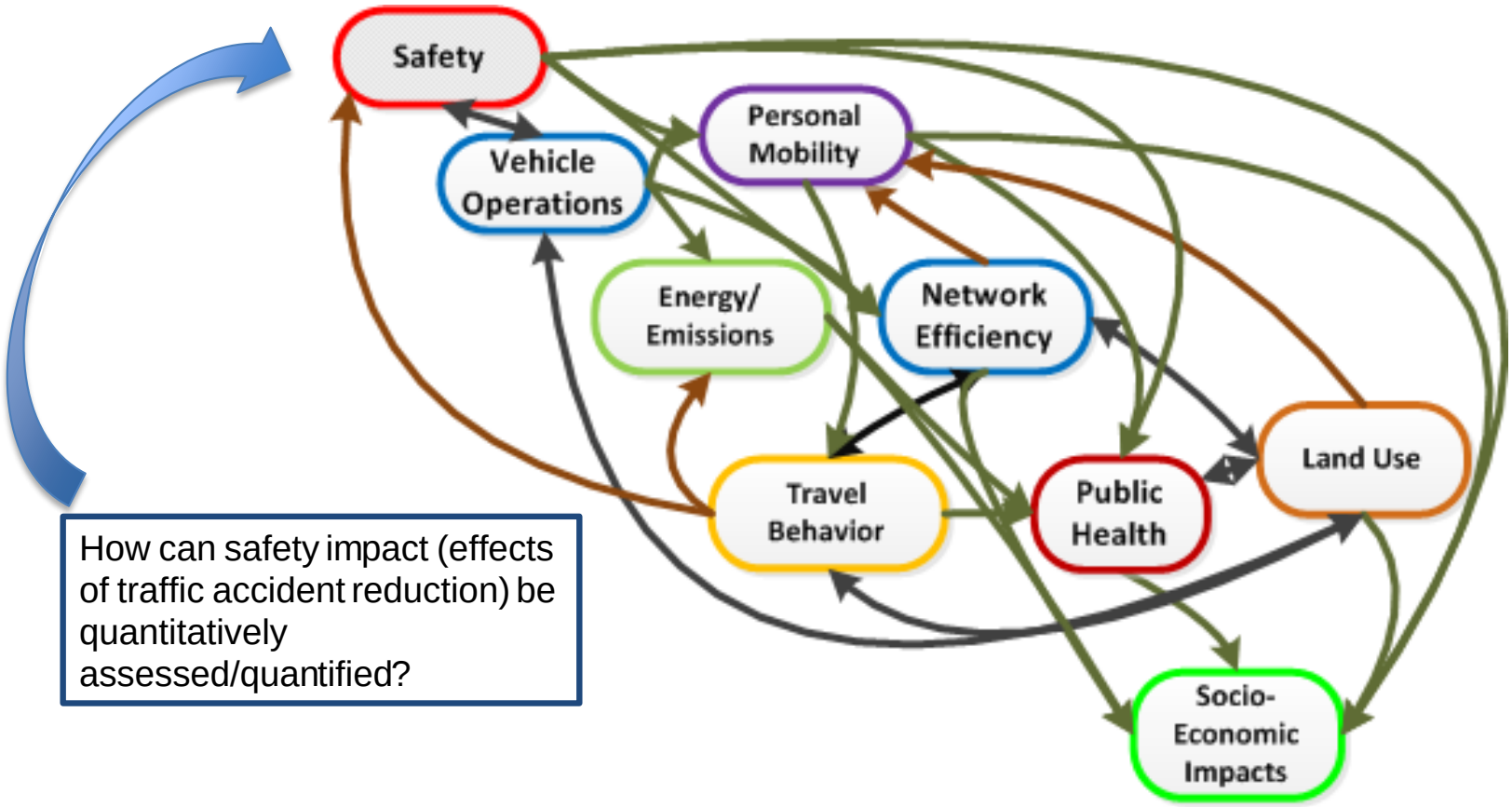
EU★US★JAPAN ITS COOPERATION

Trilateral "Impact Assessment" Sub Group

- US
- Japan
- Europe
  (Finland, Sweden, UK, Netherlands, France, Greece, Belgium, Italy, Germany)

- Sharing a framework of potential impact assessment for automated driving
- Harmonization of key performance indicators (KPIs) in various fields

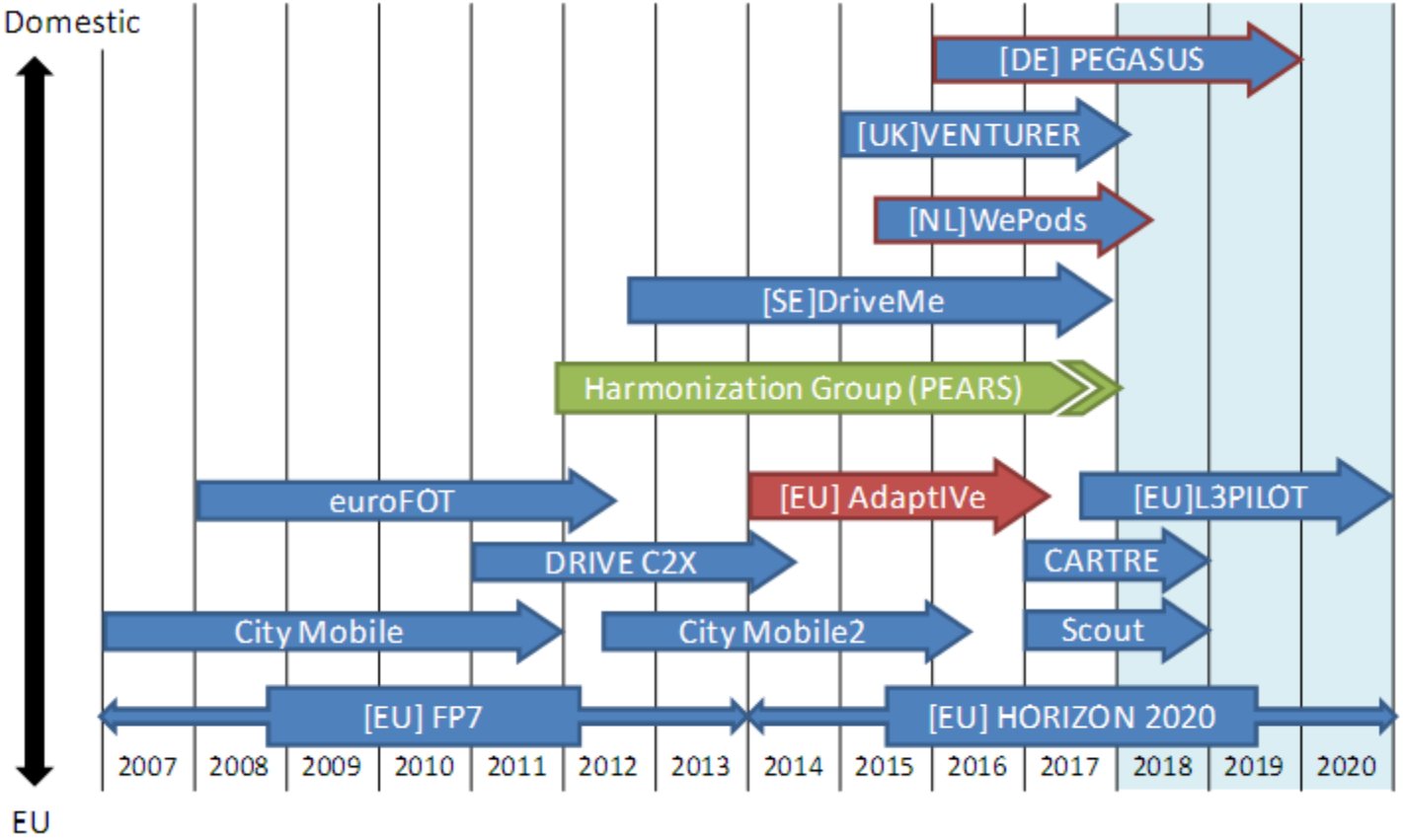
Challenge



How can safety impact (effects of traffic accident reduction) be quantitatively assessed/quantified?

Research activity of safety impact assessment (EU “AdaptiVe” project)

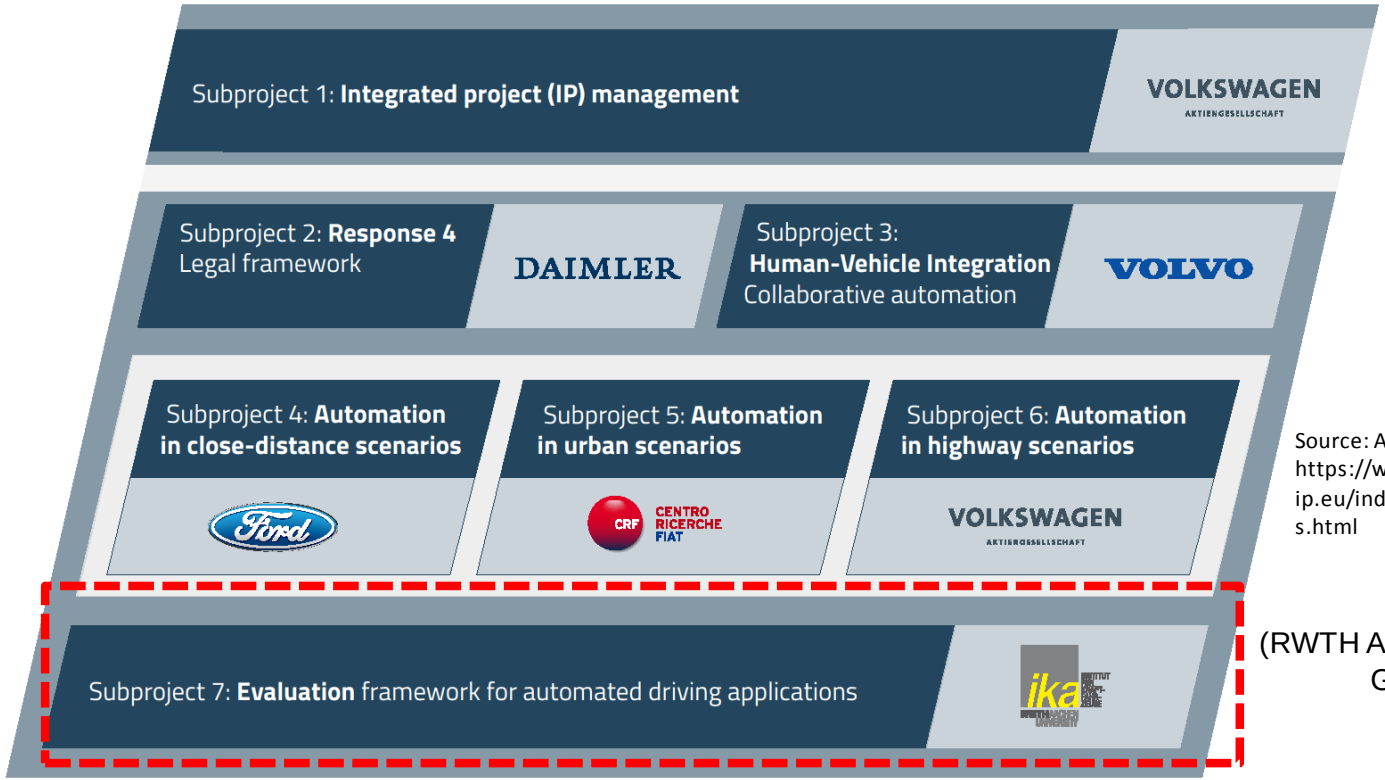
Europe: "AdaptIVe" Project



Europe: "AdaptIVe" Project

Project period: 2014 to 2017

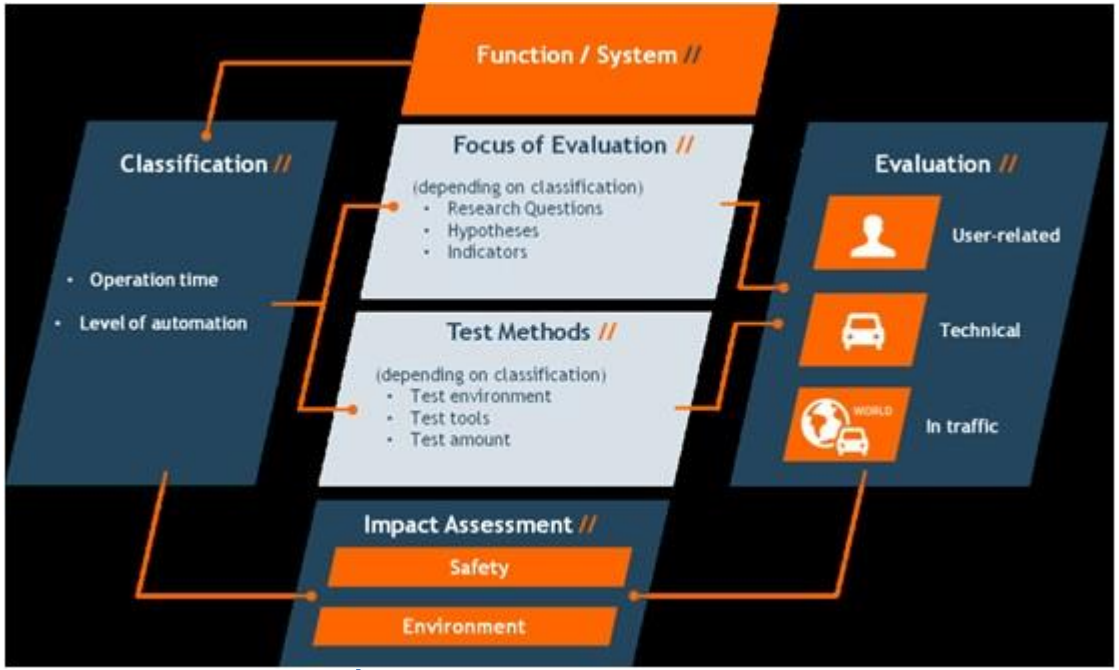
Target: Field operational tests for automated systems for highway and urban settings



Source: AdaptIVe Website https://www.adaptive-ip.eu/index.php/deliverables_papers.html

(RWTH Aachen University, Germany)

Assessment Approach in "AdaptIVe" Project

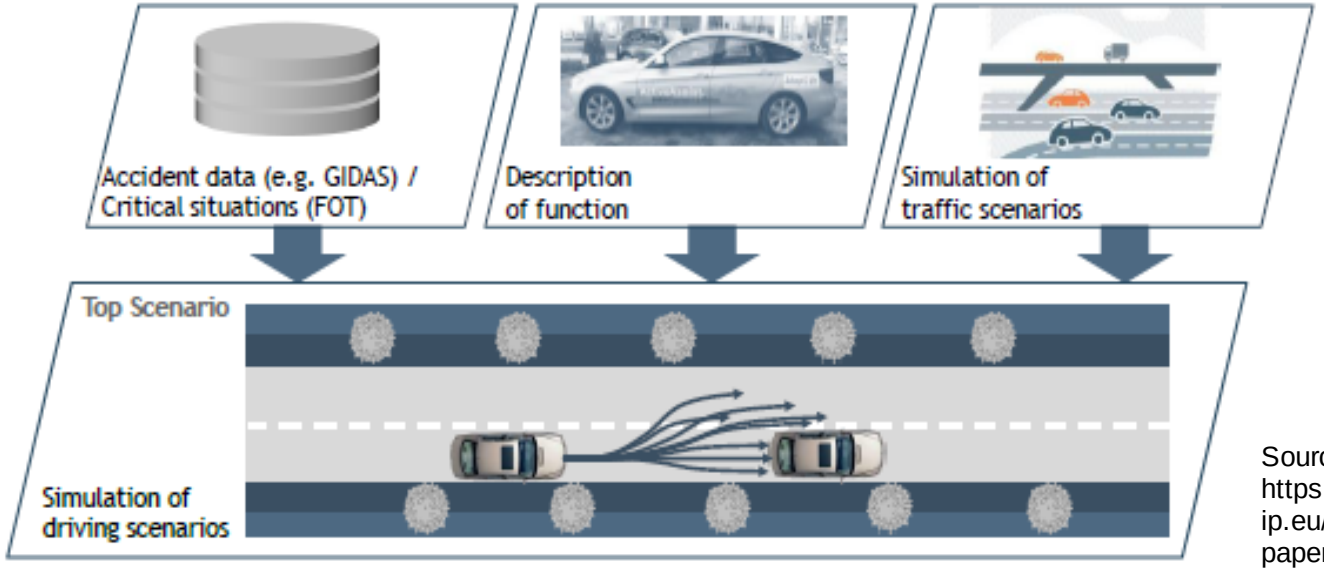


- Examined assessment methodologies
- Impact assessment for "Safety" and "Environment"
- Safety impact assessment for highway scenarios

AdaptIVe target areas	Safety impact Assessment	Environmental impact Assessment
Motorway	X	X
Urban		X
Close Distance Manoeuvring (Parking)		X

Source: AdaptIVe Website https://www.adaptive-ip.eu/index.php/deliverables_papers.html

Implementation Contents of Impact Assessment for "Safety"

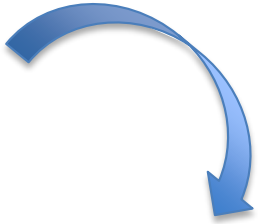


Source: AdaptIVe Website https://www.adaptive-ip.eu/index.php/deliverables_papers.html

- Highway scenarios were extracted from among traffic accidents/near-miss data in Germany
- A simulation was developed and safety impacts were assessed in top 7 critical scenarios
- Attempts were made to quantitatively assess the effects of a traffic accident reduction based on automated driving functions

Trial Results of Simulation of Effects of Traffic Accident Reduction

Driving Scenario		Proportion of accidents in GIDAS
Top 1	Cut-In	16,1%
Top 2	End in Lane	1,1%
Top 3	Obstacle in the lane	3,3%
Top 4	Approaching Traffic jam	14,4%
Top 5	Highway entrance	1,8%
Top 6	Rear-end accident	15,8%
Top 7	Single driving accident	20,6%



Source: AdaptIVe Website https://www.adaptive-ip.eu/index.php/deliverables_papers.html

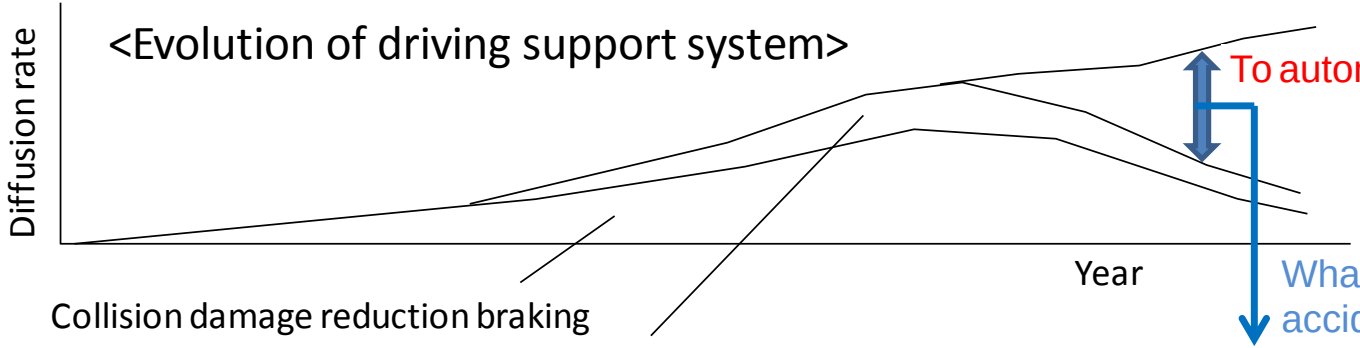
"D1.0 Final Project Results (Public)"

- The effects of a traffic accident reduction on expressways in Germany was estimated to be approximately 50%

	Top 1	Top 2	Top 3	Top 4	Top 5	Top 6	Top 7	Not Considered
Accident proportion (motorway - Germany)	14.5%	1.2%	3.4%	19.7%	1.4%	22.7%	21.8%	15.2%
Determine effect per scenario	-60% (76%)	-9% (-12%)	-31% (-39%)	-32% (-36%)	-47% (-47%)	-51% (-70%)	-67% (-93%)	0%
Accident reduction in Germany per scenario related to overall accident number	-8.7% (-11.1%)	-0.1% (-0.1%)	-1.3% (-1.6%)	-6.3% (-7.0%)	-0.7% (-0.7%)	-11.5% (-16.0%)	-14.6% (-20.3%)	0%
Overall change of the accident risk (motorway - Germany)	-43%[5] (-57%)							

Simulation development at SIP-adus (Estimation of detailed effects of traffic accident reduction)

Aim for Developing This Project



[Aim] Examination of diffusion strategy for automated driving system
(Government: Cooperative area)

[Aim] Product development of support system
(OEMs: Competitive area)

Specific accident scenario simulation

- Reproduce limited settings/times
- Traffic participants act based on the scenario
- Verify sensor specifications and control logic
- Calculate micro-level damage reduction effects

Traffic environment simulation

- Assume various areas/times
- Traffic participants act independently (recognition, judgment and operation), and have mutual impacts
  ⇒ Multi-agent
- Verify receptivity of society
- Calculate macro-level damage reduction effects

Development is necessary for diffusing automated driving

Simulation Development Plan

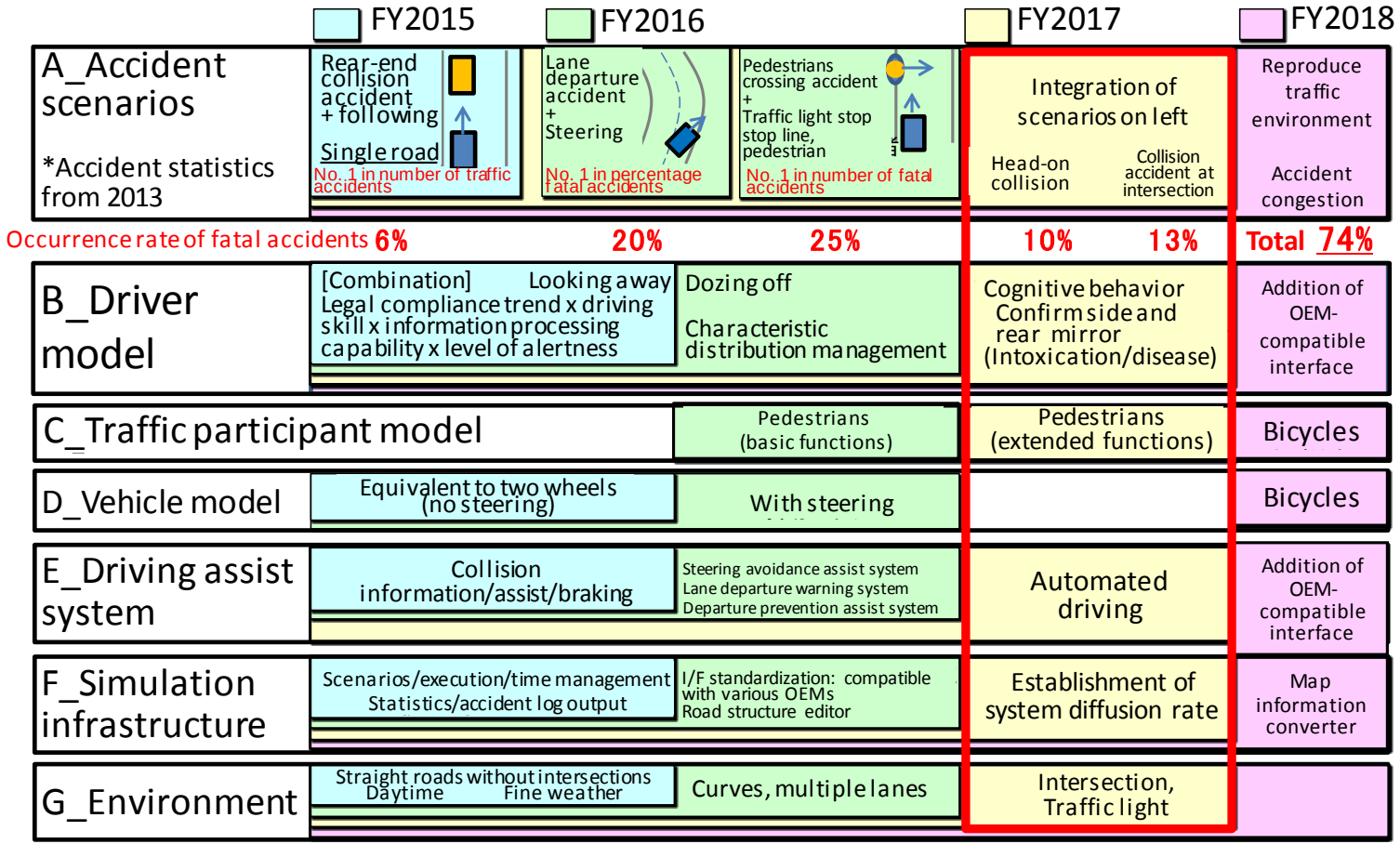
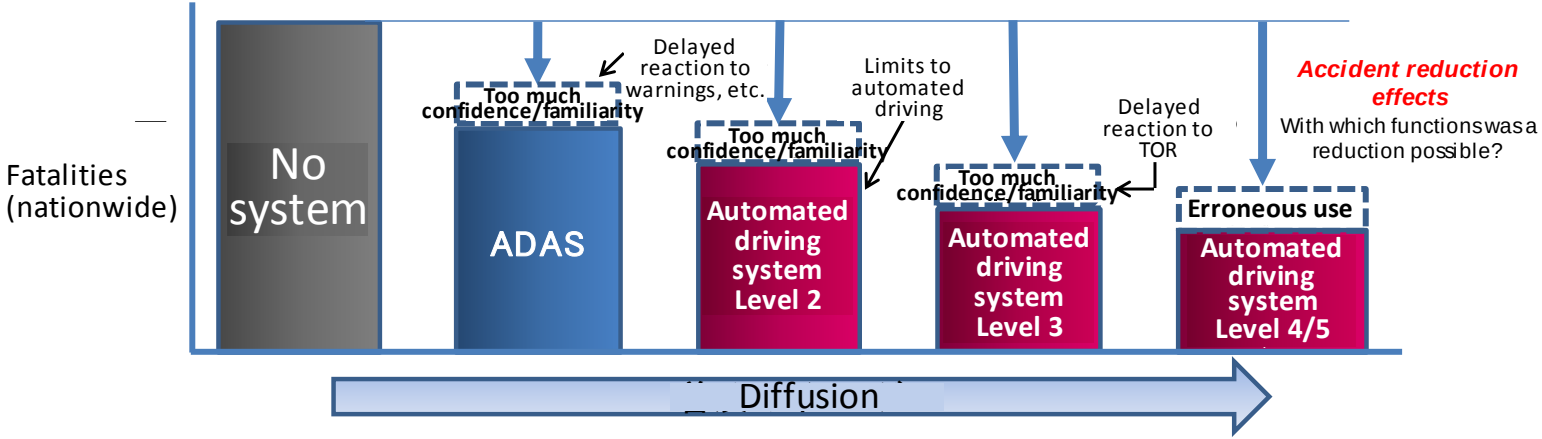


Image of Results from Simulation that Reproduces Traffic Environment

[Policy goal for public appeal]
Make the number of traffic fatalities 2,500 people or less by 2020

The target for assessing accident reduction effects is to also enable for assessment of injured persons through linkage with "Injury Assessment Module," which is based on the "number of fatalities in Japan"



[Assessment variation]
- Each of the 5 accident scenarios & total
- Diffusion rates: 30%, 60%, 100% (tentative)

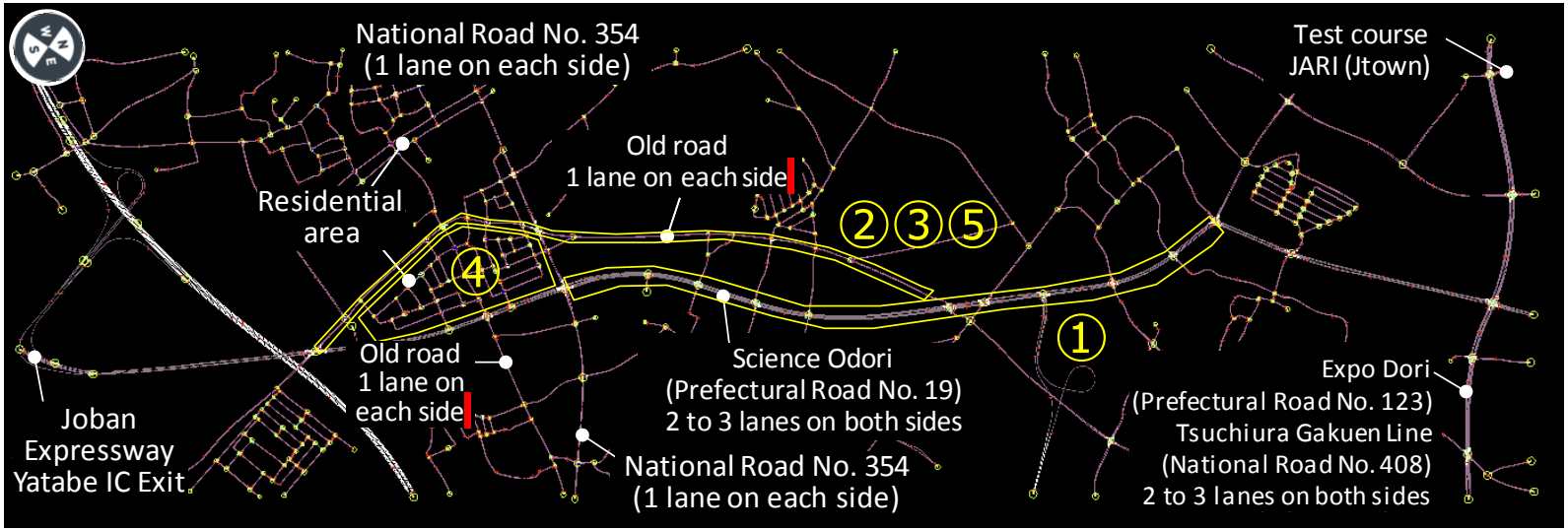
Diffusion Conditions in Simulation

Scenarios for manual driving, collision damage reduction braking, and where collision damage reduction braking, lane departure warning system, and automated driving system are intermixed were established

Scenario		(1)	(2)	(3)	(4)	(5)	(6)
Manual driving		100%	50%	25%	25%	25%	
Automated driving system	Collision damage reduction braking (AEB)		50%	25%			
	Collision damage reduction braking + Lane departure warning (LDW)			50%	50%	25%	25%
	Automated driving system				25%	50%	75%

Simulation Implementation Conditions

The road environment* in Tsukuba City was constructed, and 5 accident scenarios were reproduced
Accident reduction effects based on an automated driving system were calculated, and functional confirmations were implemented



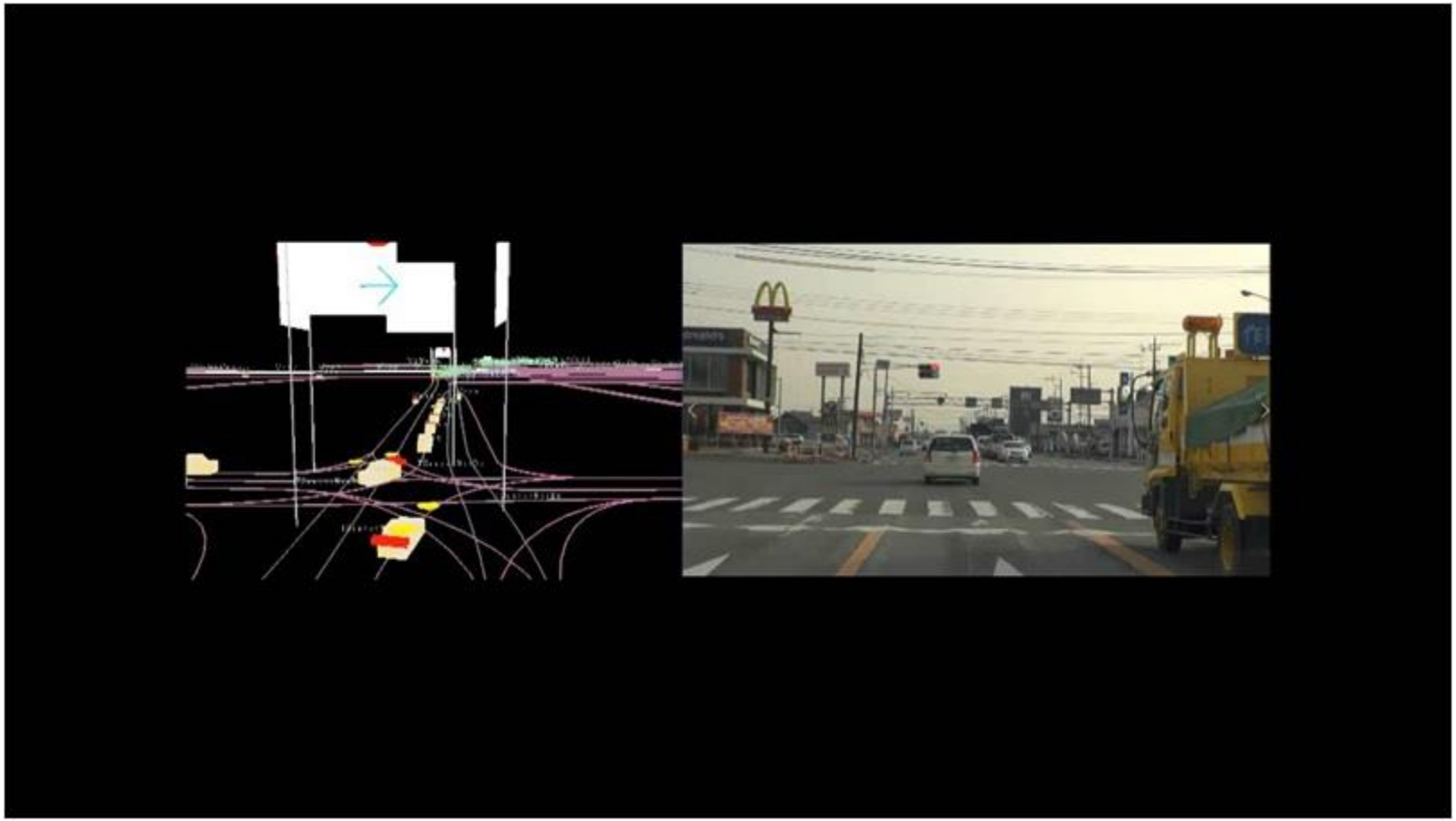
① Following/rear-end collision (Science Odori)
② Head-on collision (Old road)
③ Lane departure (Old road)
④ Collision at crossing (Residential street)
⑤ Pedestrian crossing (Old road)

Traffic density: Numbers were postulated by conducting a road traffic census for main roads, and field surveys for non-main roads

Execution Screen for Simulation that Reproduces Traffic Environment

6 km x 3 km range / Approx. 500 agents (vehicles & pedestrians)

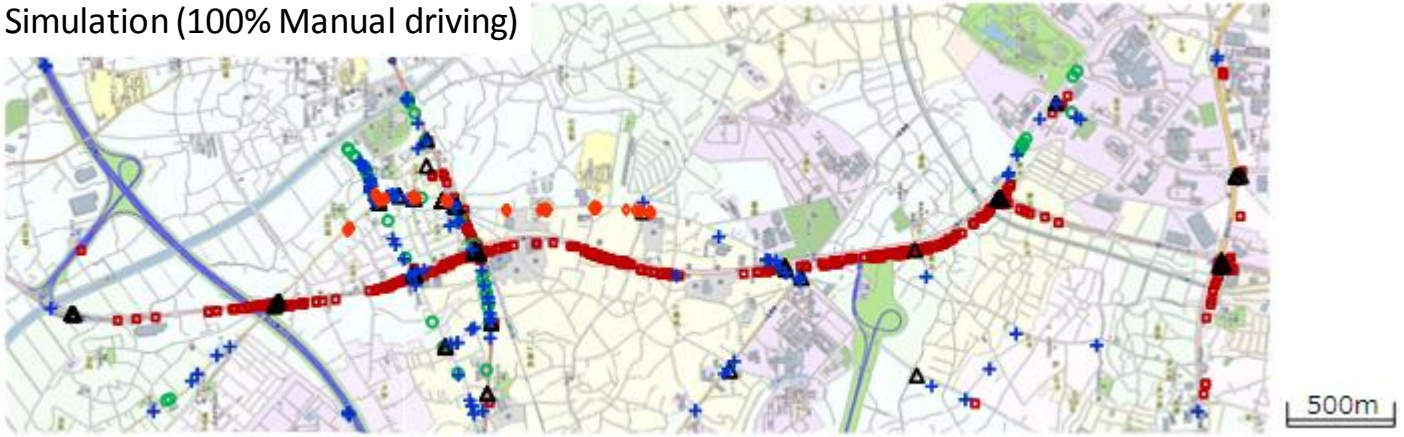
Comparison between Actual Traffic Environment and Simulation



Samples of Traffic Accident Occurrence Conditions

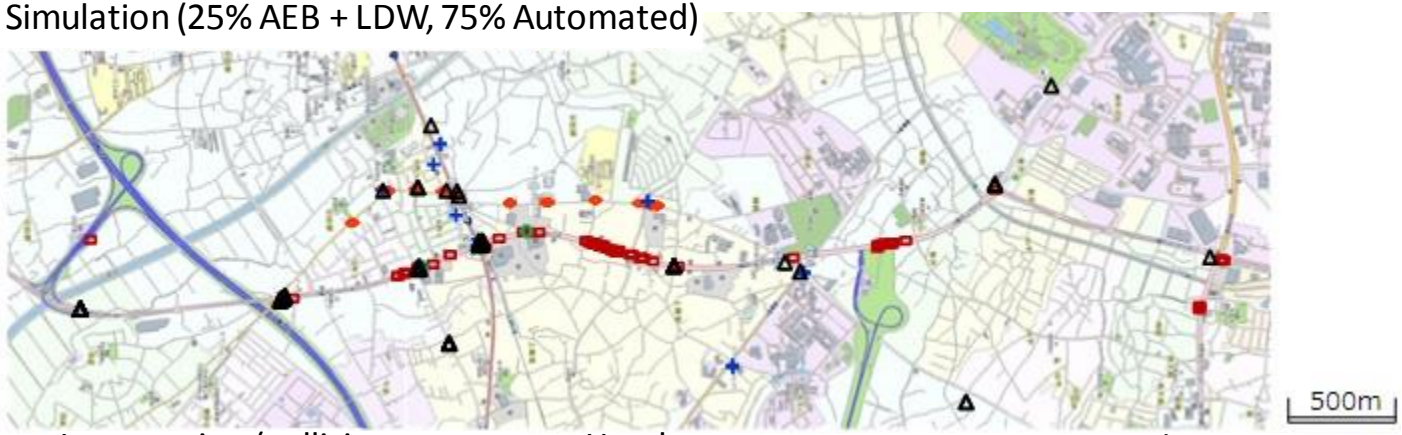
Simulation (100% Manual driving)

Diffusion scenario (1)



Simulation (25% AEB + LDW, 75% Automated)

Diffusion scenario (6)



Rear-end collision

Intersection (collision at crossing + right turn)

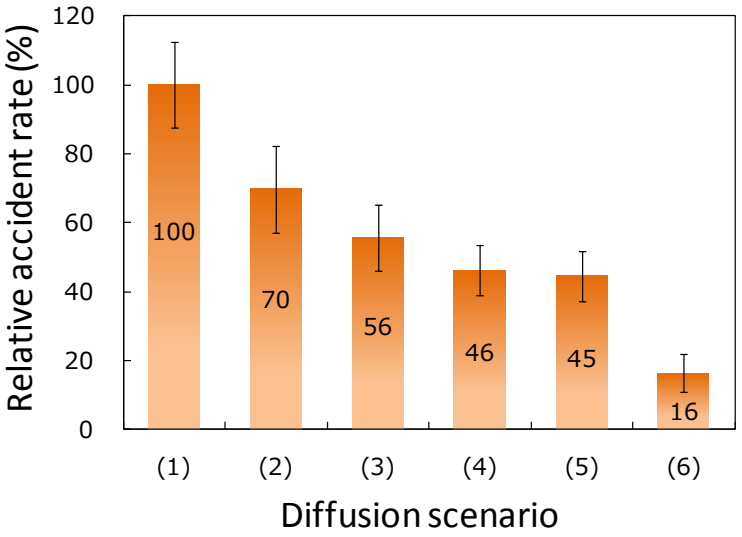
Head-on collision

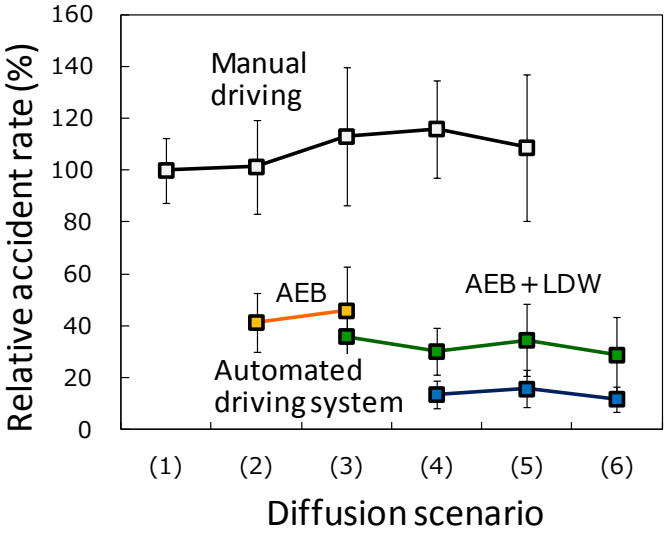
Lane departure

Pedestrian crossing

Estimation of Accident Reduction Effects By Diffusion Scenario (Preliminary Results)

It was confirmed that simulations for calculating accident reduction effects of ADAS, such as collision damage reduction braking, as well as an automated driving system function under provisional prerequisites





Diffusion scenario

(1) 100% Manual

(2) 50% Manual, 50% AEB

(3) 25% Manual, 25% AEB, 50% AEB + LDW

(4) 25% Manual, 50% AEB + LDW, 25% Automated driving

(5) 25% Manual, 25% AEB + LDW, 50% Automated driving

(6) 25% AEB + LDW, 75% Automated driving

Summary

1. International cooperation activities (Trilateral “Impact Assessment” SG)

- Discussion of framework for impact assessment based on automated driving technology

2. Research activity of safety impact assessment (EU “AdaptiVe” project)

- Examination of methods for functional assessment of automated driving system (final demo implemented in June 2017)
- Estimate effects of a highway accident reduction through a simulation based on driving scenarios

3. Simulation development at SIP-adus (Estimation of detailed effects of traffic accident reduction)

- Development of a simulation that reproduces the traffic environment (multi-agent)
- Public road area (6 km x 3 km) was set, and rear-end/head-on collisions, lane departures, collision at crossings, and pedestrian crossing accidents were simulated
- Quantitative assessment of accident reduction effects associated with diffusion of an automated driving system was attempted as a preliminary study


Thank you