

24.11.22 VVM Final Event



The Japanese Safety Assurance Approach

JARI

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Overview of SAKURA project

◆ Projects aim

- Harmonize data collection, develop research methodologies
- Coordinate standardization activities through joint efforts with JAMA and academia
- Establish a continuous safety evaluation eco-system for safer AD development

◆ Facts about the projects

– Funded by METI

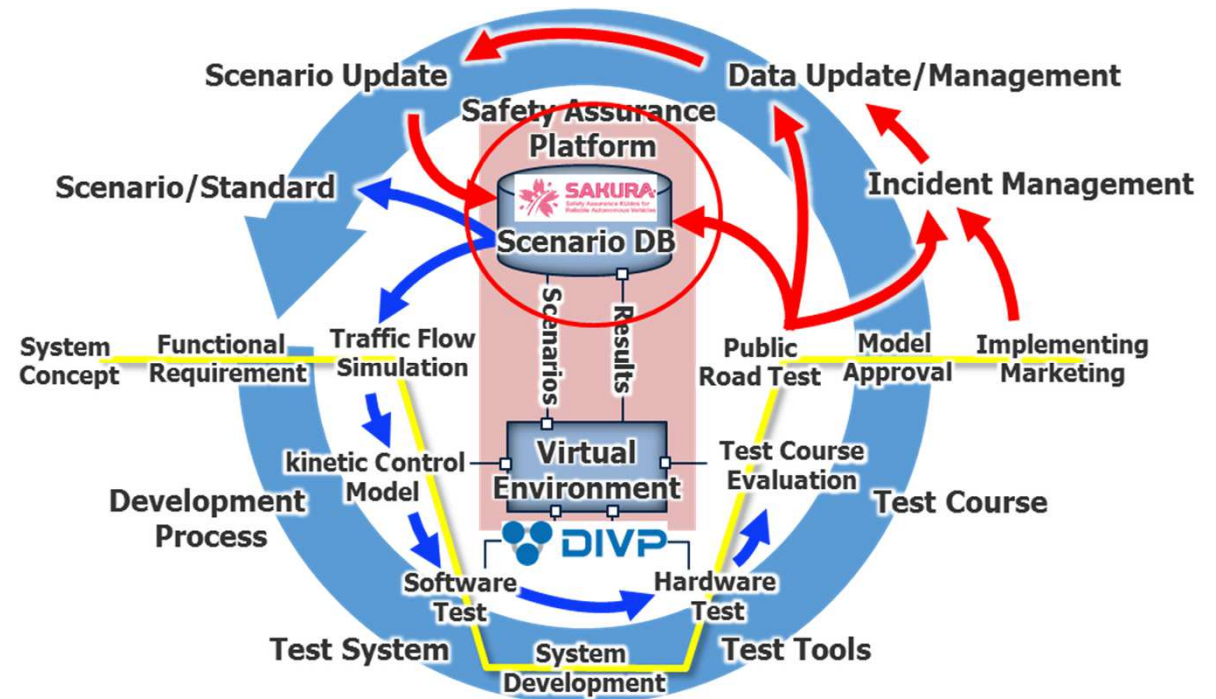
1.26 Bio JPY(FY22)

1.59 Bio JPY(FY23, incl. DIVP)

– Duration

2018-2020(Phase1)

2021-2025(Phase2)



Structure of Japanese safety assurance activity

Common Foundation of ADS safety assurance

- ◆ **Methodology: converge complicated real traffic into finite number of scenarios**
 - Scenario based approach
 - Defining reasonably foreseeable and preventable boundary
 - Output as JAMA Framework and standards (ISO34502, UN R157)



Automated Driving Safety Evaluation Framework Ver 3.0

Japan Automobile Manufacturers Association, Inc.
Second Committee of AD Safety Evaluation,
Automated Driving Subcommittee
December 2022

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- ◆ **Application: traceable evidences and practical testing tool**

- SAKURA database
- Integration with virtual platform (DIVP)

Current status of FS development

◆ Car to Car Scenario

- Consideration of **turning maneuver**, **oncoming vehicle** and **intersection**
- Converged into 58 Functional Scenarios

◆ Car to Pedestrian Scenario

- Pedestrian behavior are simply described
- First draft provides 8 FS



Highway
24 Scenarios

Road sector and subject-vehicle behaviour	Subject-vehicle behaviour	Surrounding traffic participants location and behaviour											
		Going straight				Lane change / Swerving				Turning			
		Same / Crossed(from R/L) direction		On coming		Same / Crossed(from R/L) direction		On coming		Same / Crossed(from R/L) direction		On coming	
non-intersection	Going straight (Lane keep)	sc01	sc02	sc03	sc04	sc05	sc06	sc07	sc08	sc09	sc10	sc11	sc12
	Lane change	sc13	sc14	sc15	sc16	sc17	sc18	sc19	sc20	sc21	sc22	sc23	sc24
Merge zone	Going straight (Lane keep)	sc25	sc26	sc27	sc28	sc29	sc30	sc31	sc32	sc33	sc34	sc35	sc36
	Lane change	sc37	sc38	sc39	sc40	sc41	sc42	sc43	sc44	sc45	sc46	sc47	sc48
Branch zone	Going straight (Lane keep)	sc49	sc50	sc51	sc52	sc53	sc54	sc55	sc56	sc57	sc58	sc59	sc60
	Lane change	sc61	sc62	sc63	sc64	sc65	sc66	sc67	sc68	sc69	sc70	sc71	sc72
Intersection	Going straight (Lane keep)	sc73	sc74	sc75	sc76	sc77	sc78	sc79	sc80	sc81	sc82	sc83	sc84
	Turning	sc85	sc86	sc87	sc88	sc89	sc90	sc91	sc92	sc93	sc94	sc95	sc96

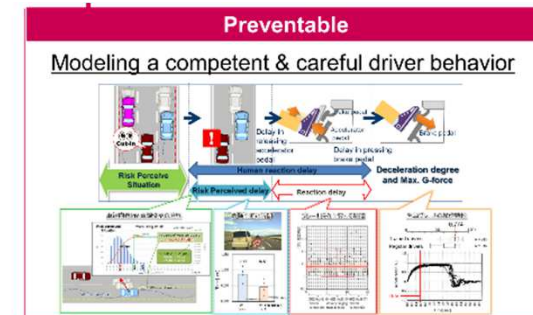
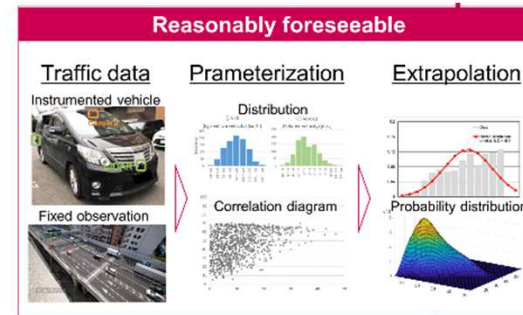
Urban 58 Scenarios

		Pedestrian behavior	
		Walk in driving path	Cross driving path
Non intersection	Go straight	P01	P02
	Lane change	P03	P04
Intersection	Go straight	P05	P06
	Turn	P07	P08

SAKURA database in the context of SA toolchain

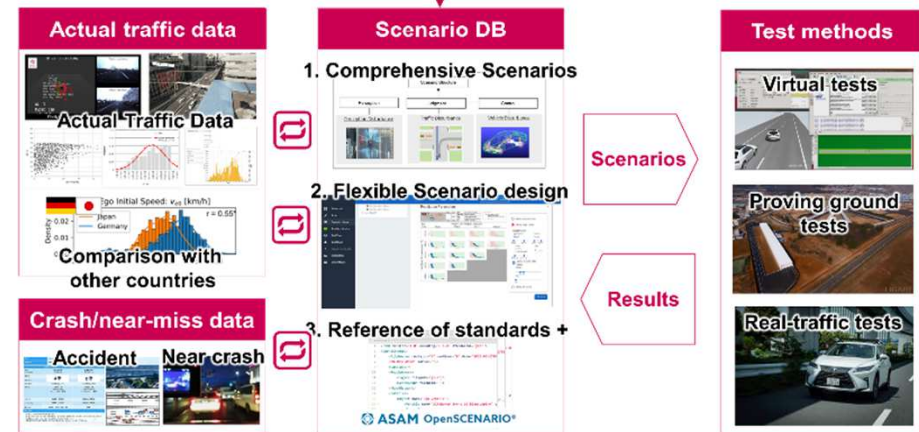
◆ Quantify foreseeable and preventable

- **Measurement of traffic data**
 - Validate functional scenarios
 - Estimate parameter distribution
- **Modelling C&C driver behavior**
 - Preventable boundary



◆ Integrate with testing methods

- Provide relevant exposure
- Near crash/Accident scenarios
- Output concrete scenarios



Quantitative definition of reasonable foreseeable

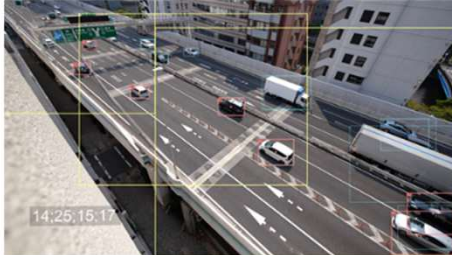
- ◆ Derive relevant exposure parameter range from real traffic data

Traffic data

Instrumented vehicle

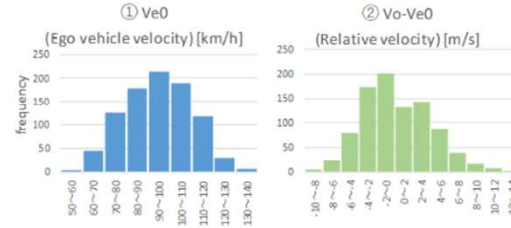


Fixed observation

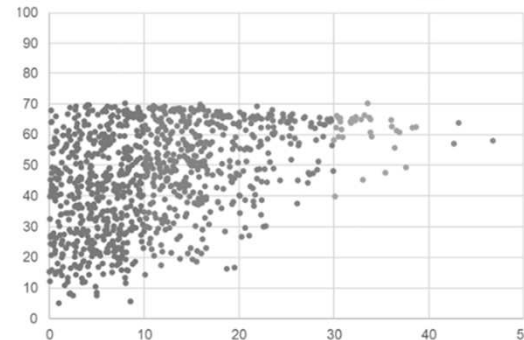


Parameterization

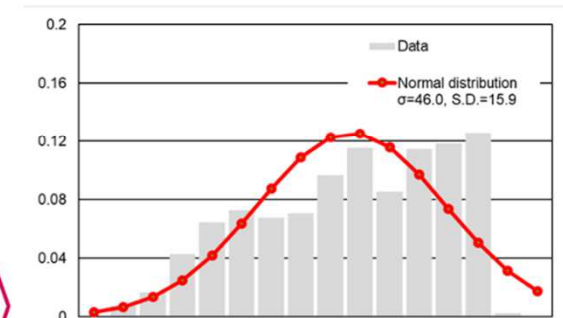
Distribution



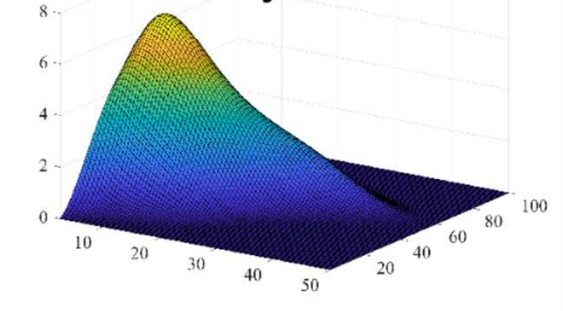
Correlation diagram



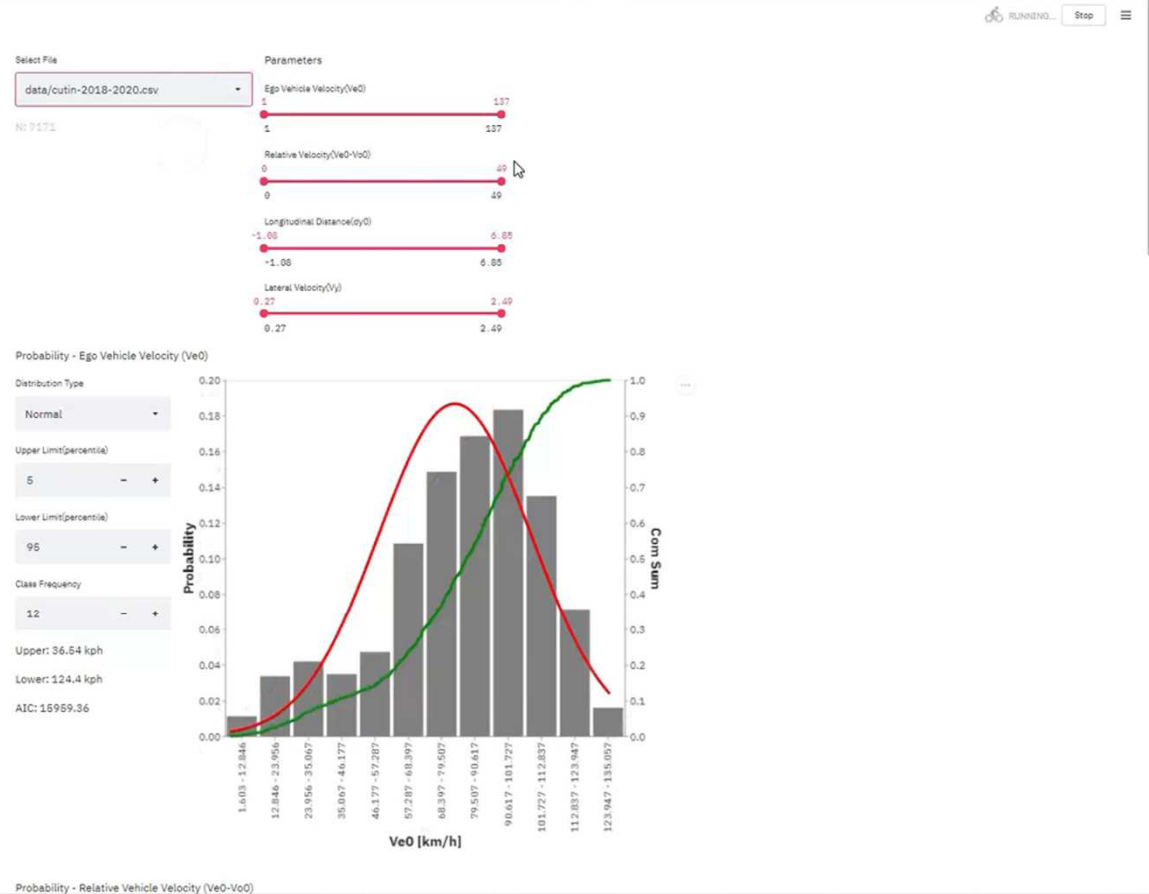
Extrapolation



Probability distribution

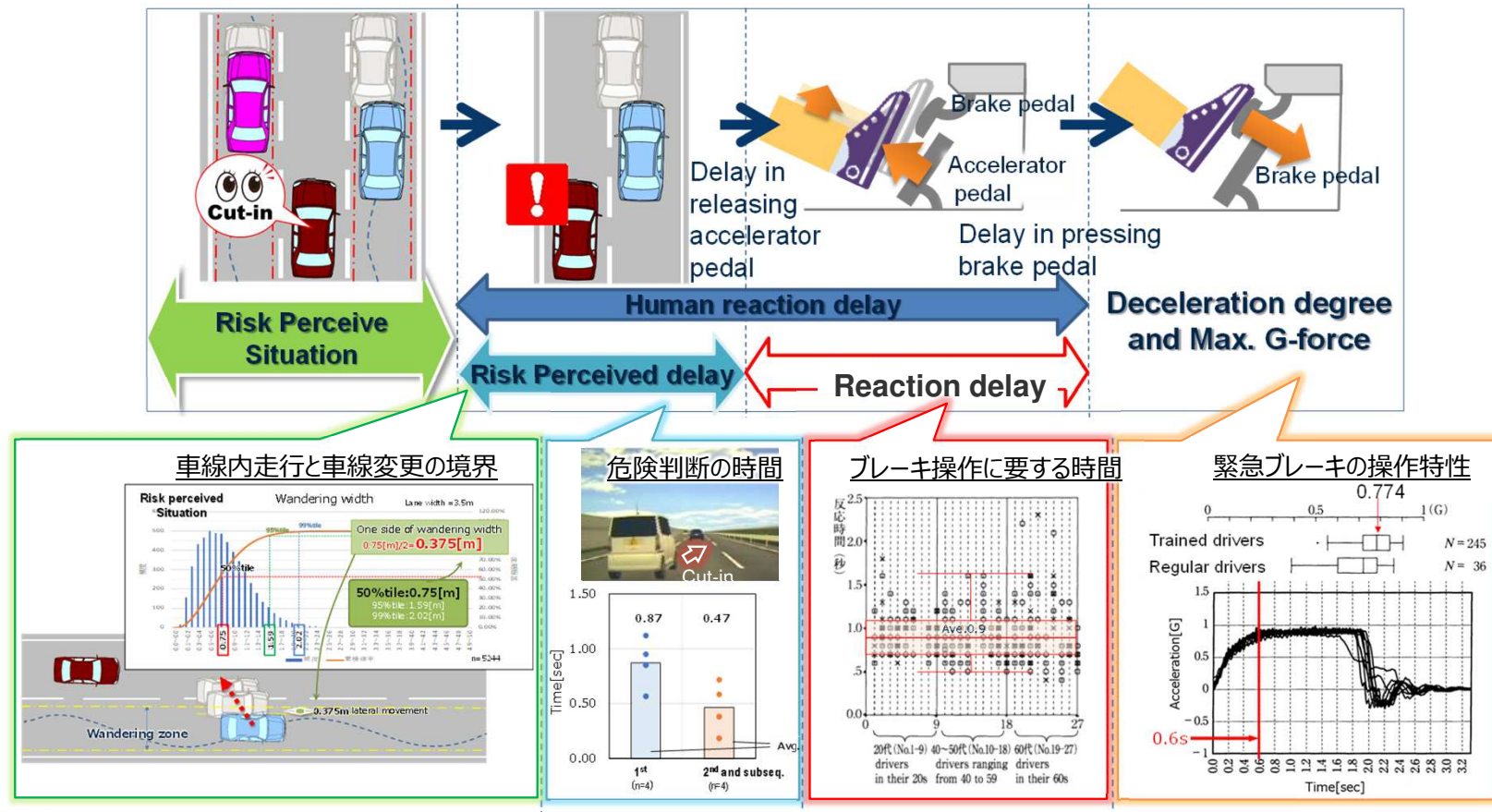


Demo of traffic flow database



Determination of preventable boundary

◆ Derive preventable boundary base on C&C human driver model



Demo of scenario database

Scenario Database Project: FY2023 AD FMC UserID: scenario_demo_f

Test Specification Test Case

- ALKS
 - Cut-in ego speed -60kph
 - Deceleration ego speed -60kph
 - Cut-in
 - ALKS-Edge Case
- ALL test data
 - ALKS Cut-in Ego60kph relative 40kph ALL
 - Euro NCAP

PARAMETER
REGULATION GRAPH

Regulation Parameters

Initial condition	Initial velocity	Ve0 Ego vehicle velocity
		Ve0-Vo0 Relative velocity
Initial distance		dy0 Lateral distance*
		dx0 Longitudinal distance
Vehicle motion	Lateral motion	Vy Lateral velocity

*Lateral distance
ex) Lane width : 3.5 [m]
Vehicle width: 1.9 [m]
Driving in the center of the lane
dy=1.6 [m]

	dy0- 1.6m	Relative velocity [Ve0-Vo0][kph]			
		10kph	20kph	30kph	40kph
60kph					
50kph					
40kph					

Verify any one case

Target Graph

Ego Vehicle Speed

20kph

Other vehicle lateral speed

0.05 m/s

Relative Speed

10kph

Initial inter-vehicle distance

0 m

Verify edge cases

Verify all cases

Summary

- ◆ SAKURA project is developing traffic interaction scenario
- ◆ Implementing scenarios as SAKURA database
- ◆ It will maximize the value of concrete test cases (simulations)

