

Informal Document VMAD-04-04
4th VMAD IWG, Oct 16-17,2019
Agenda item 5.

Safety Criteria Study on Innovative Safety Validation Methods of Automated Driving System

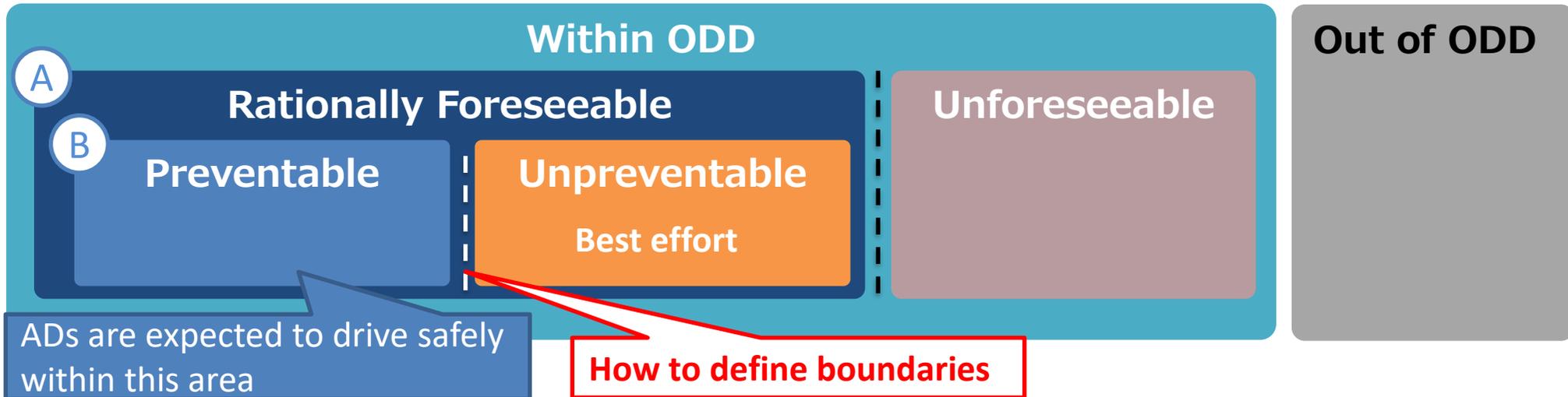
Oct 16-17, 2019

Transmitted by experts of Japan

Schematic structure of the safety requirement

[WP29 Framework Document]

Within ODD, AD shall not cause **(A) rationaly foreseeable** and **(B) preventable** accident resulting injury or death



- (A) Foreseeable:** It is important to cover the events occurring in the actual traffic situation.
=>Specify the foreseeable range based on the actual traffic data in line with the scenario structure.
- (B) Preventable:** Socially acceptable criteria for AD needs to be defined through further discussion.

VMAD SG1a Statement

As for the rational boundary conditions, we think it is appropriate to set the ability of ADS at general public understand as attentive skilled human driver level without any human errors as a first step.

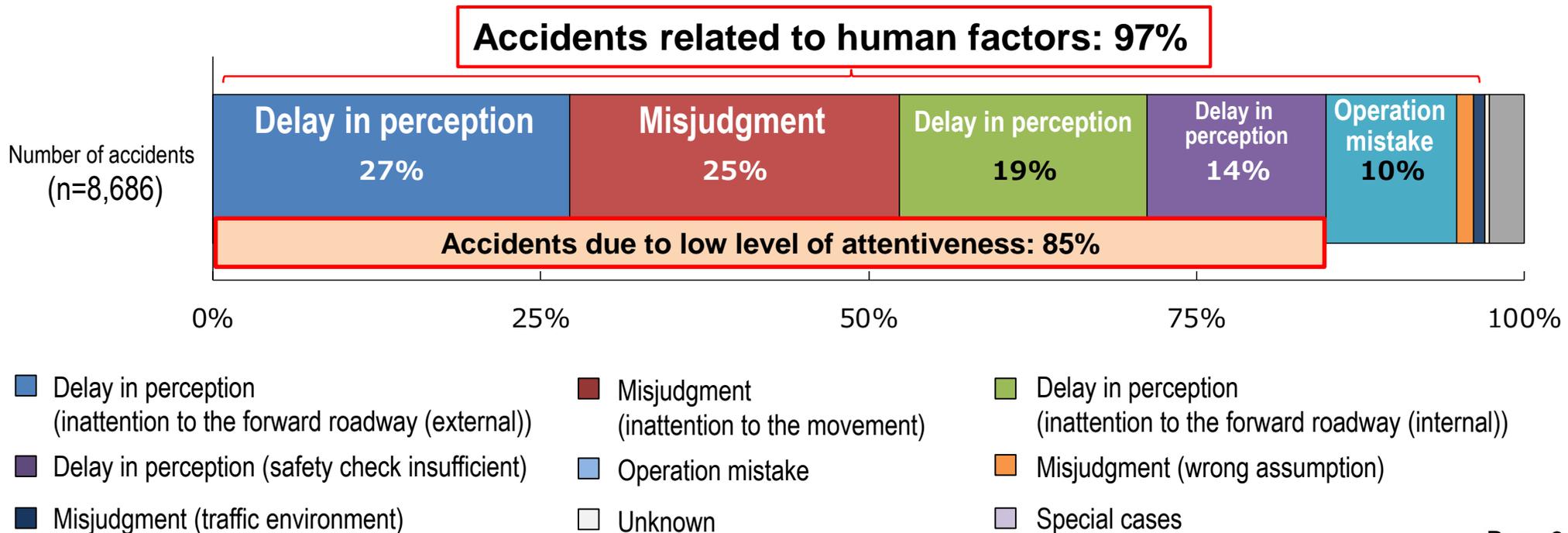
Accident Rate Caused by Human Factors of Driver (Highway)



- 97% of the accidents were related to the human factors of driver. **(of which 60% was due to delay in perception)**
- Most of the accidents can be prevented **if the driver's level of attentiveness is high.**

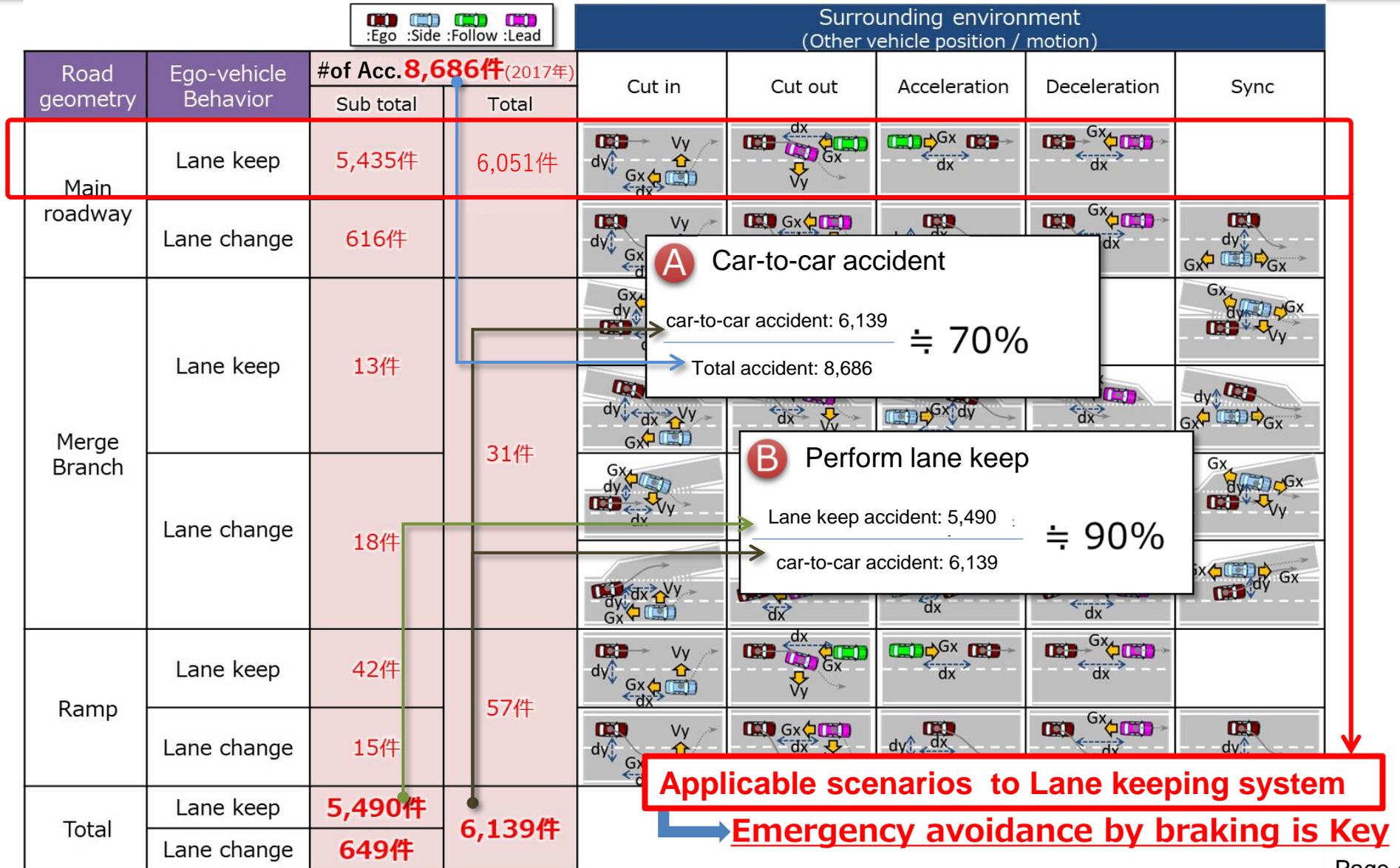
■ Data collection criteria:

Accidents occurred on highways in Japan in which the primary responsible party was a vehicle (automobile/motorcycle) (2017)



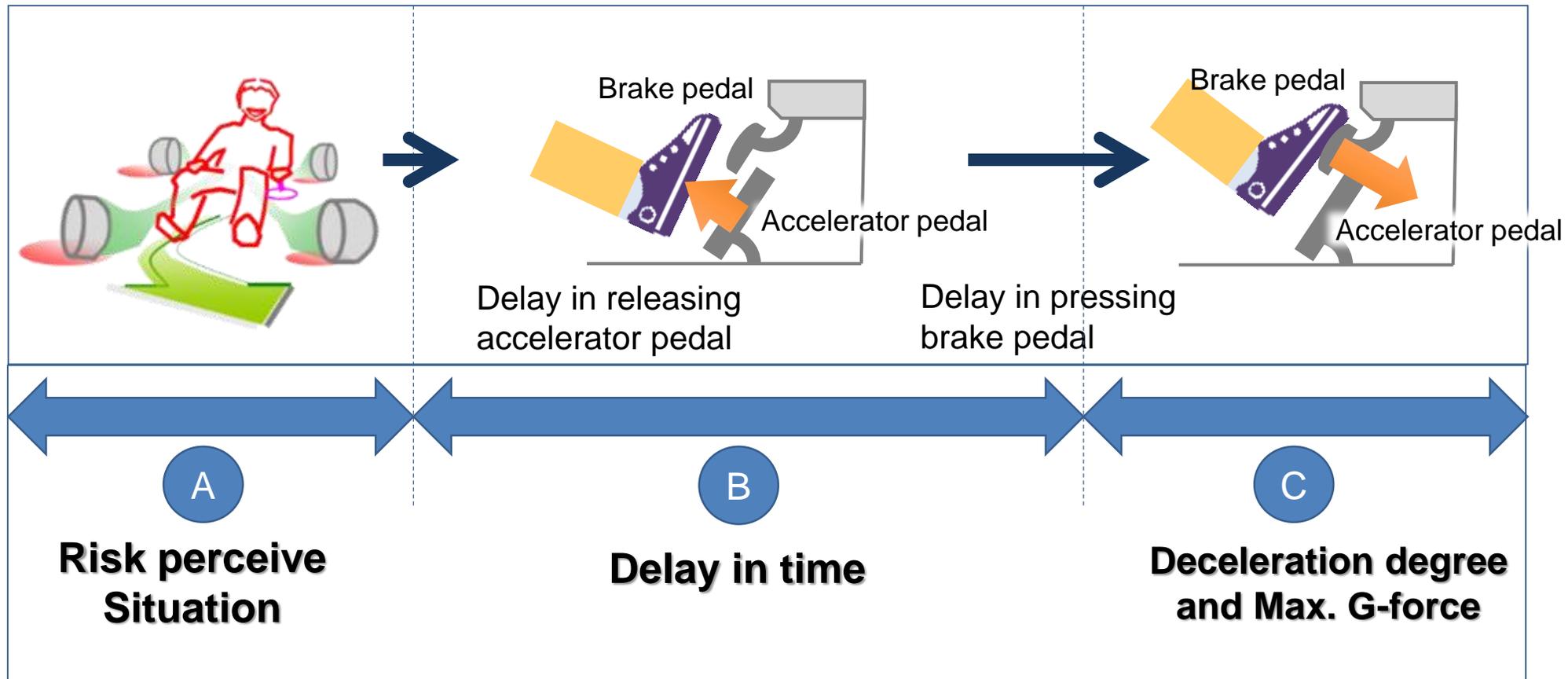
Accidents on the Highways

A 70% of the accidents were car-to-car on the highways, and **B** in 90% of which, the primary responsible party did not perform lane change



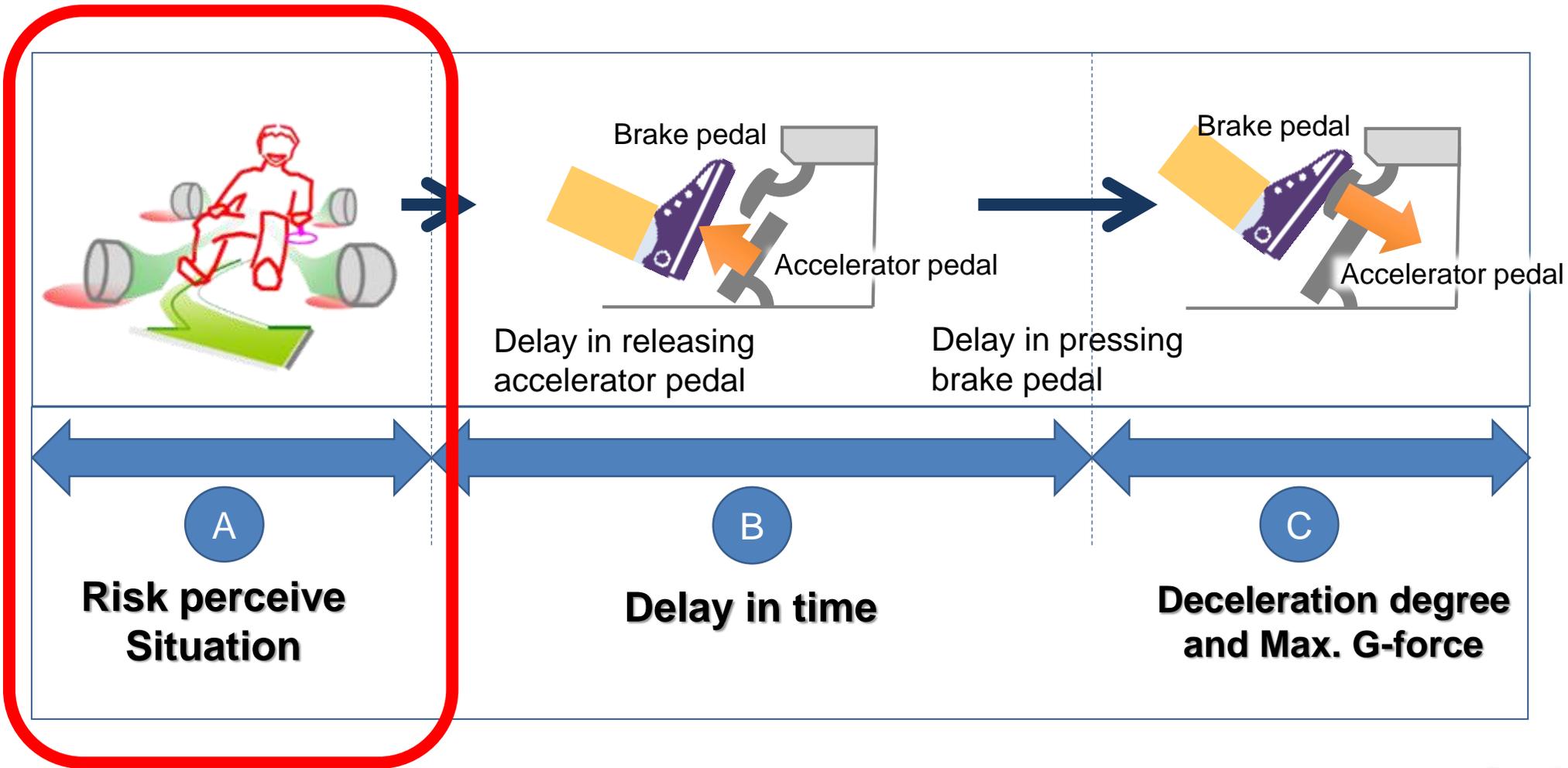
Driver Model Structure

In low-speed ALKS scenario, the avoidance capability required for the driver model is braking control only. This driver model is separated into the following three segments: “Risk perceive situation”, “Delay in time”, and “Deceleration degree and Max. G-force”



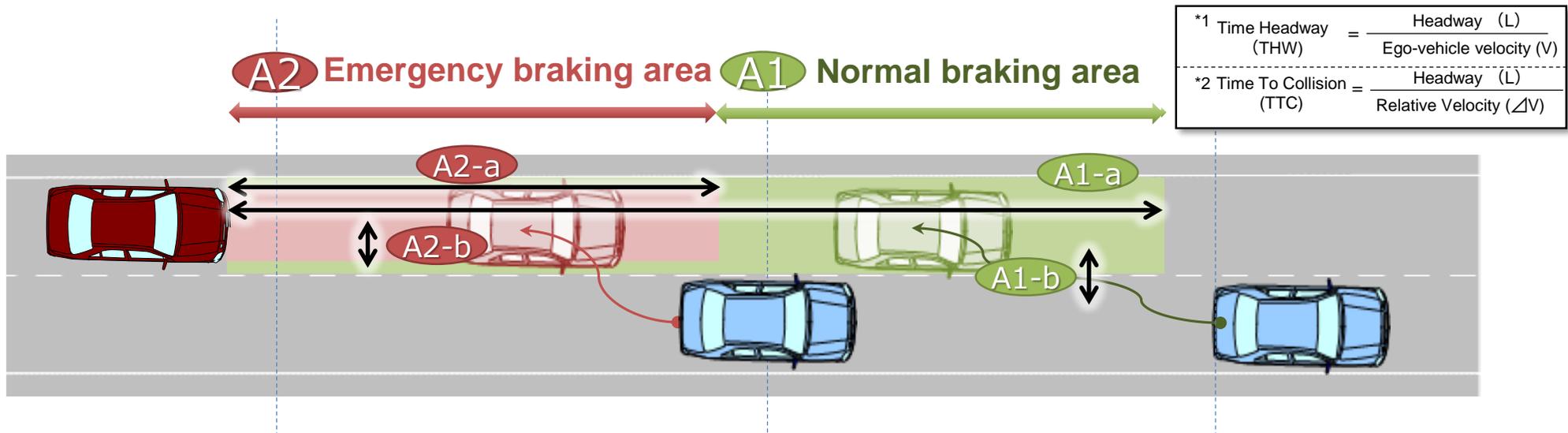
Risk perceive Situation

In low-speed ALKS scenario, the avoidance capability required for the driver model is braking control only. This driver model is separated into the following three segments: “Risk perceive situation”, “Delay in time”, and “Deceleration degree and Max. G-force”



A Concept of "Cut In Risk Perceive Situation"

Separately define Risk perceive situation for Emergency braking and Normal braking area



A1 Normal braking area

- AND
- A1-a Risk perceive area in longitudinal direction
 - A1-b Risk perceive start timing in lateral direction

- ▣ Time Headway (THW)*1
- ▣ Distance from ego-vehicle's lane marking

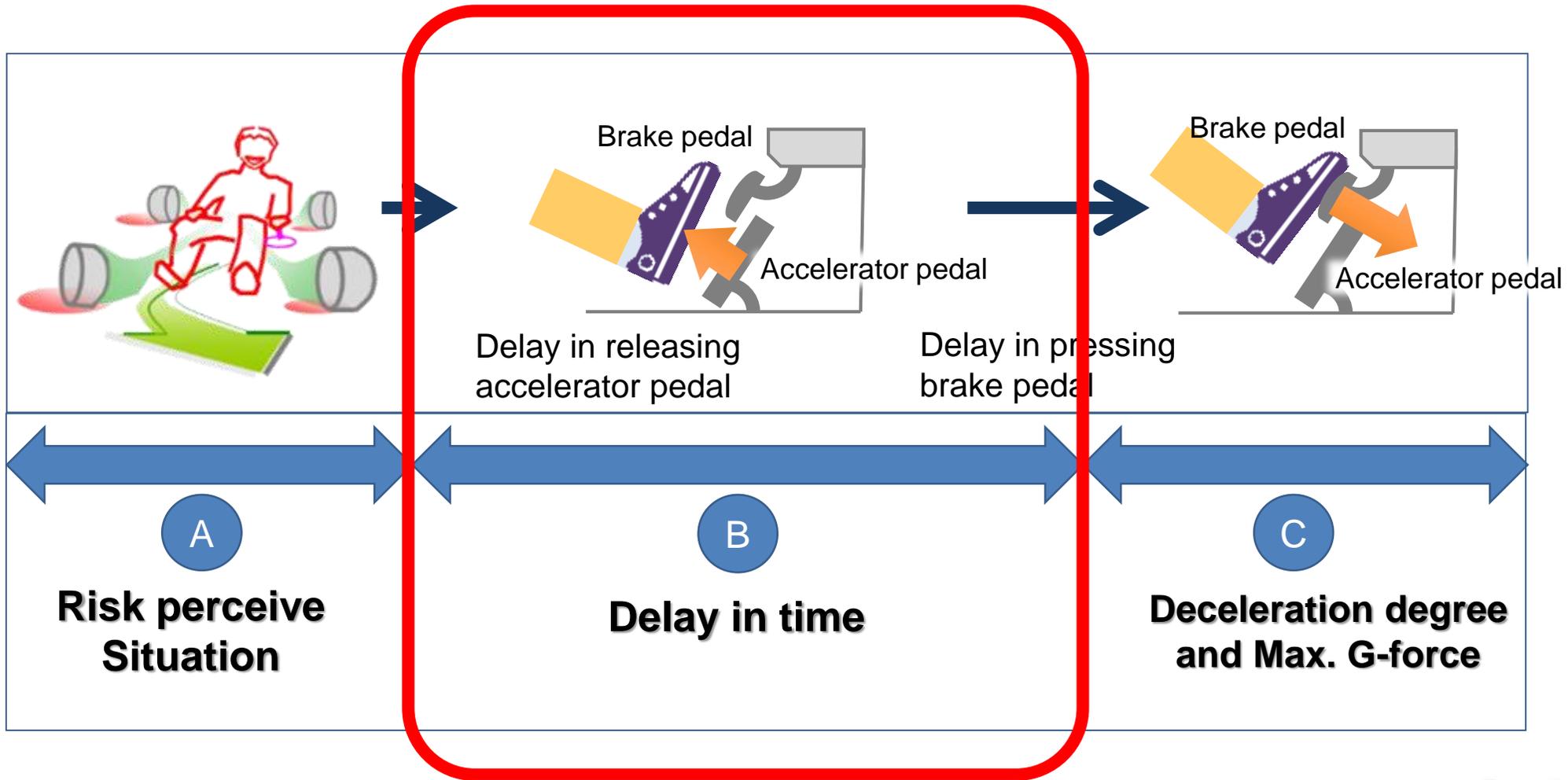
A2 Emergency braking area

- AND
- A2-a Risk perceive area in longitudinal direction
 - A2-b Risk perceive start timing in lateral direction

- ▣ Time To Collision (TTC)*2
- ▣ lateral movement of Side vehicle

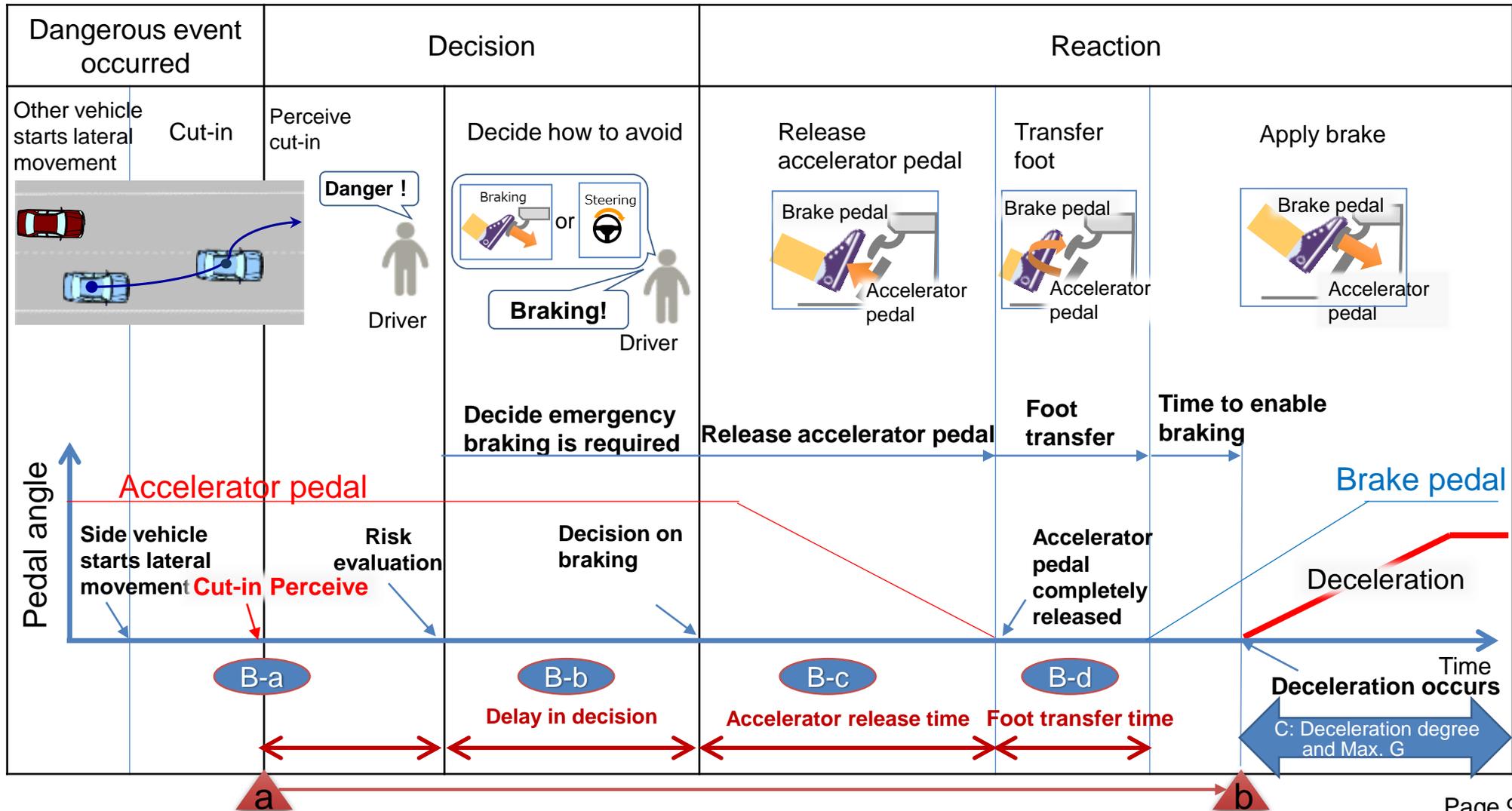
Delay in Time

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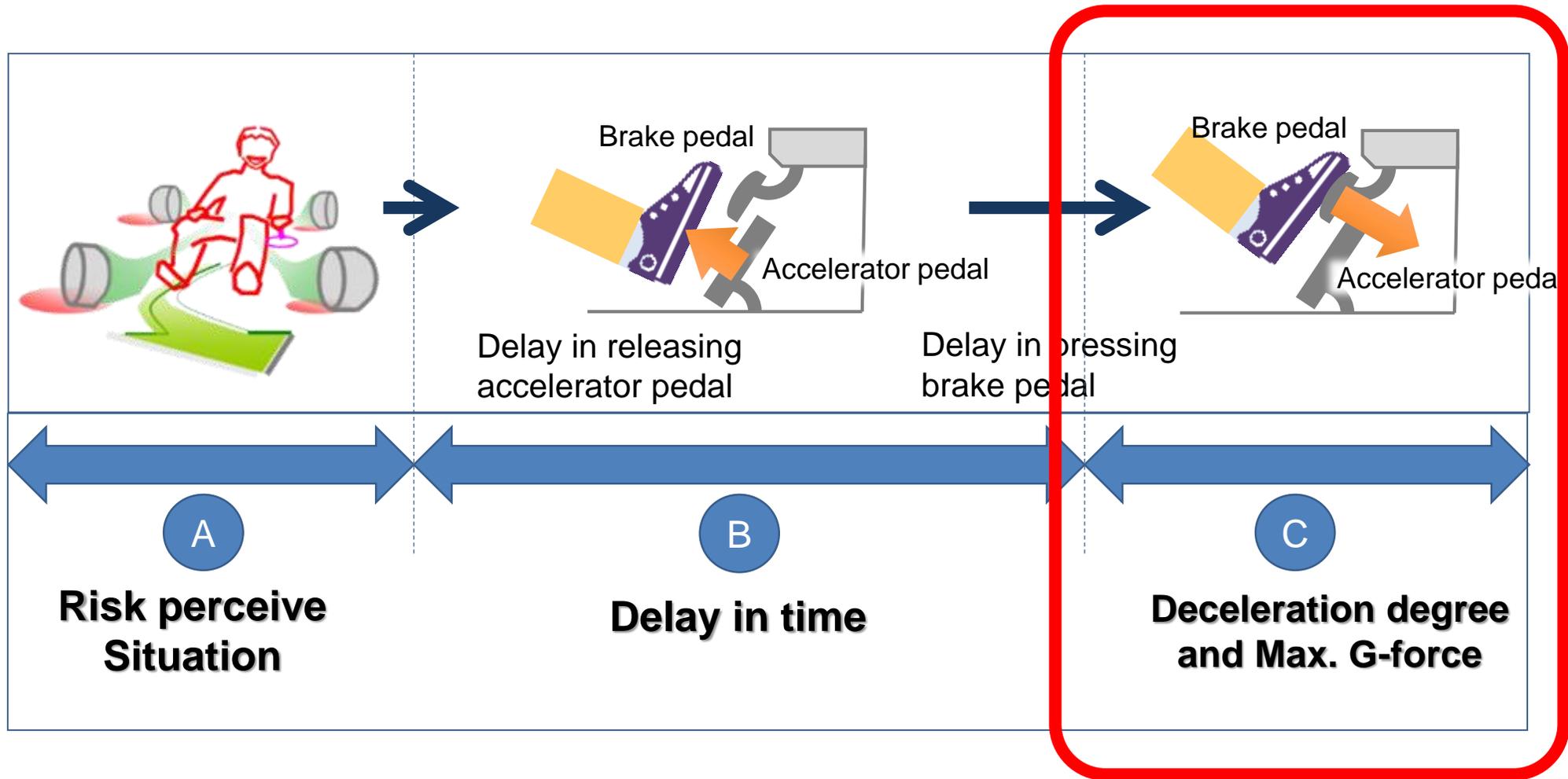
B Delay in Decision/Reaction

“Delay in time” occurs in each driving process of human: “Perception-Decision-Reaction”
 Define total delay in time from **a** occurrence of dangerous event to **b** occurrence of deceleration



Deceleration degree and Max. G-force

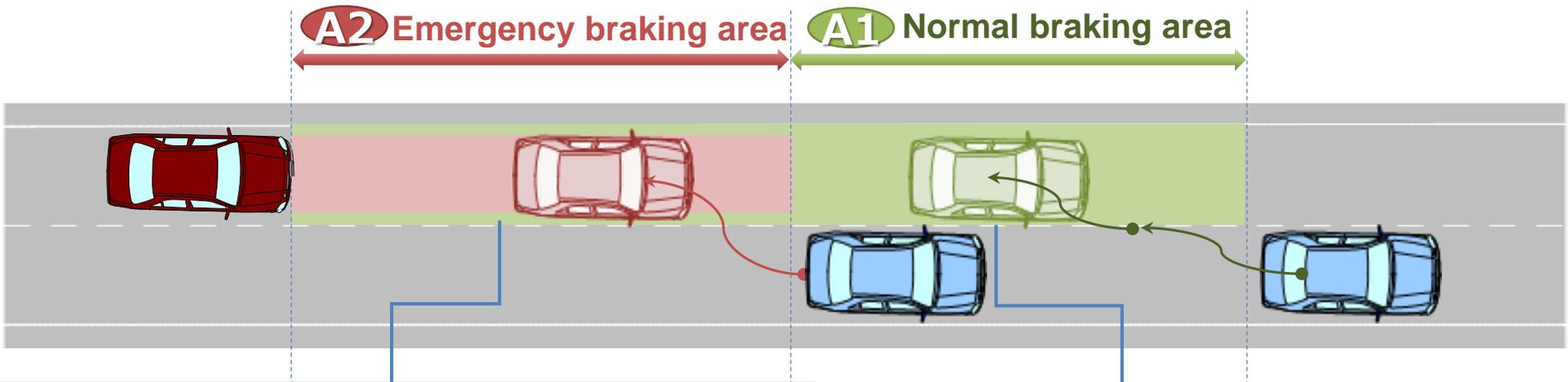
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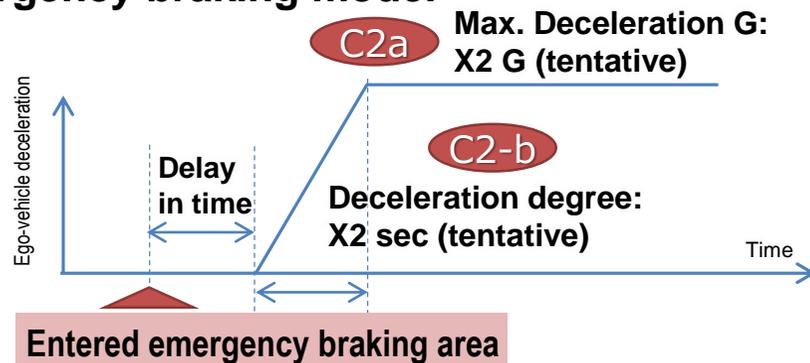
C

Deceleration Degree and Max. G-force

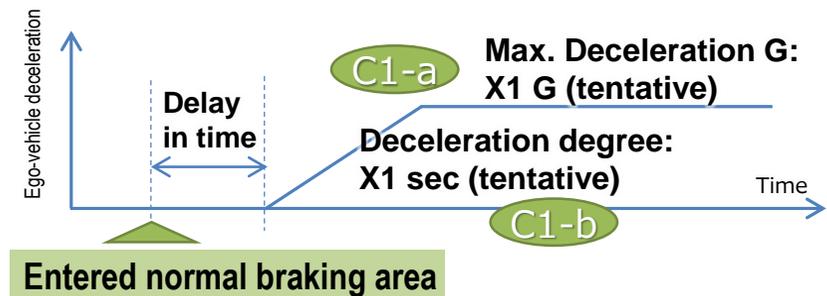
Required braking force (deceleration degree and max. g-force) varies between the normal braking and emergency braking
=> Separately specify the driver model for the normal braking and emergency braking



Emergency braking model

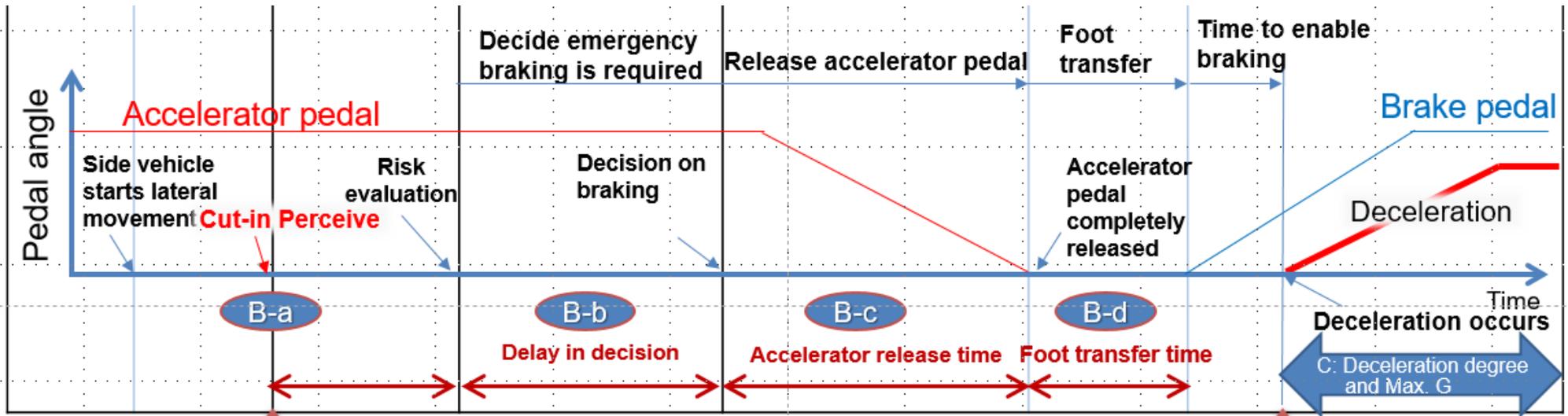


Normal braking model



Summary

1. Please Let us know your comment regarding attentive skilled human driver model based on the consideration in each country.
2. Please propose quantitative parameters of **Emergency braking area (B-a, B-b...)** with rationale like experimental data.

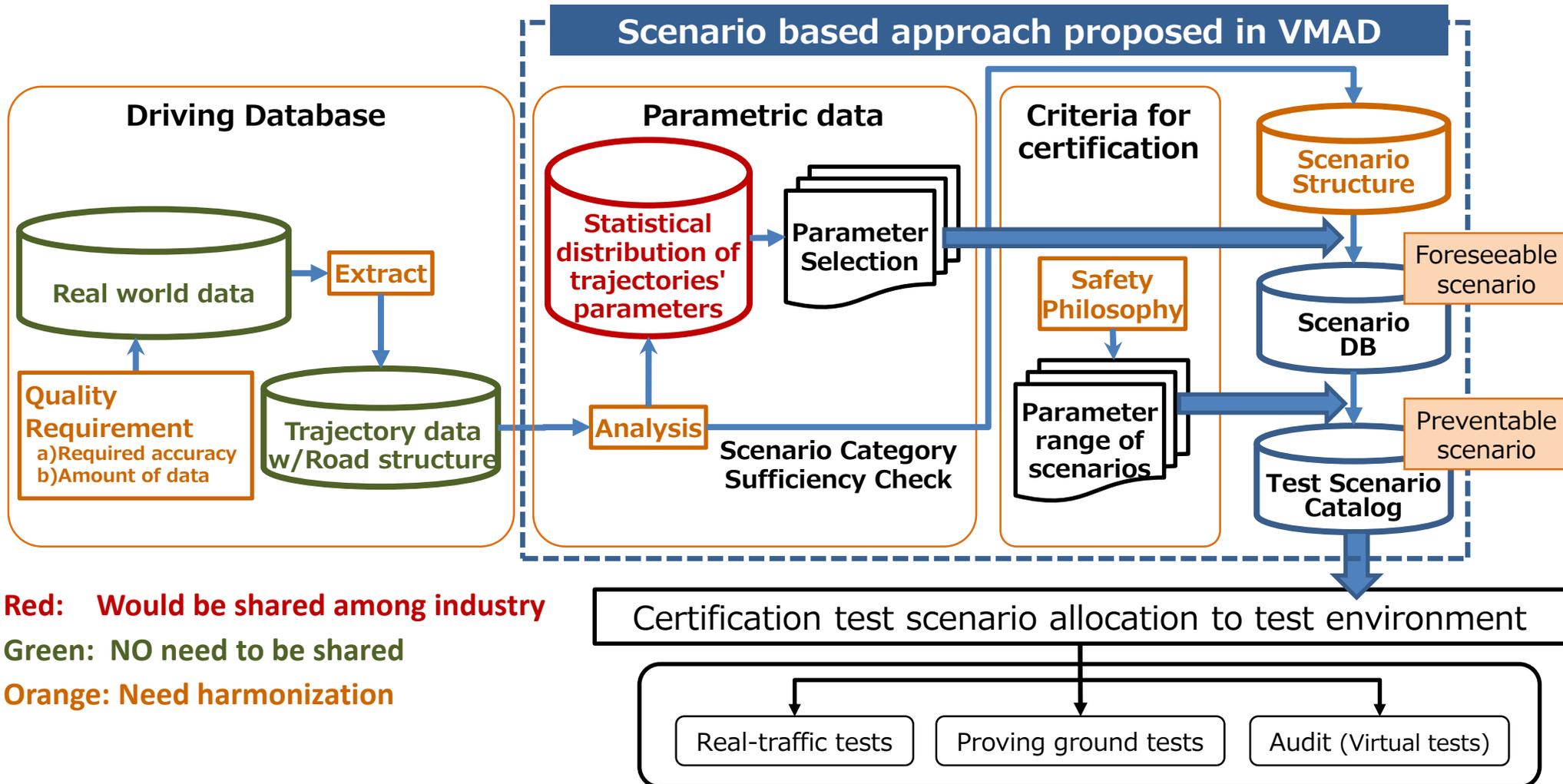


3. Safety evaluation scenarios using numerical model for low-speed ALKS will be presented at the next VMAD meeting.

APPENDIX

Scenario based approach process

It is recommended to harmonize the scenario DB within the necessary range according to the process shown below to verify the differences of traffic environment in each country.



Scenario based approach process

Further discussions toward the harmonization of the following topics are required between the representatives from each member state.

