Benefits of SIP “Automated Driving Systems”

September 11, 2014

Seigo Kuzumaki

TOYOTA Motor Corporation

Cross-ministerial Strategic Innovation promotion Program (SIP)

Purpose of SIP Automated Driving System

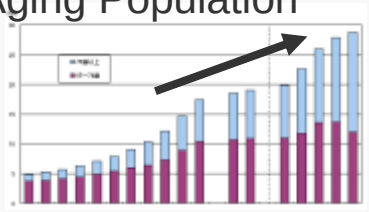
Social benefits

- Drastic reduction of traffic fatality
- Reduction of traffic congestion
- Enhanced mobility for the aged
- Reduction of driving workload

Congestion

Traffic

Aging Population



Automated Driving System
（built-in and connected）

Technology innovation

- Highly advanced driving assistance
- Innovative transportation systems

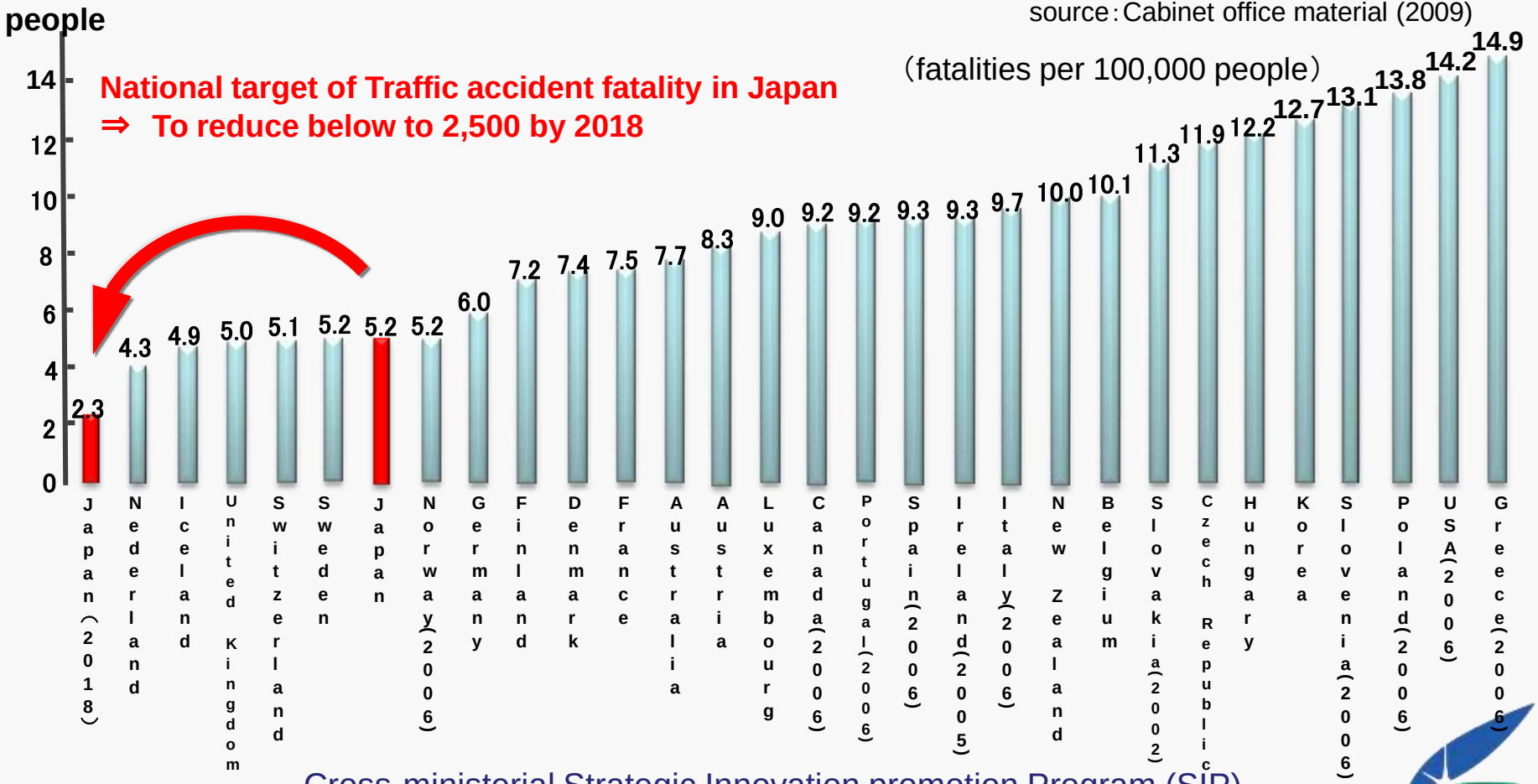
Business incubation

- Auto and electronic industries
- Creation of new industrial sectors

SIP : Cross-Ministerial Strategic Innovation Promotion Program

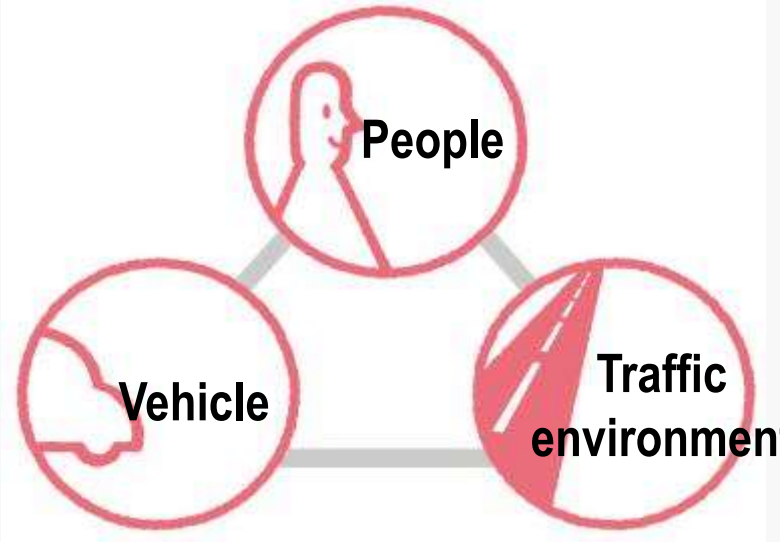
Traffic accident fatality in the world

source：Cabinet office material (2009)

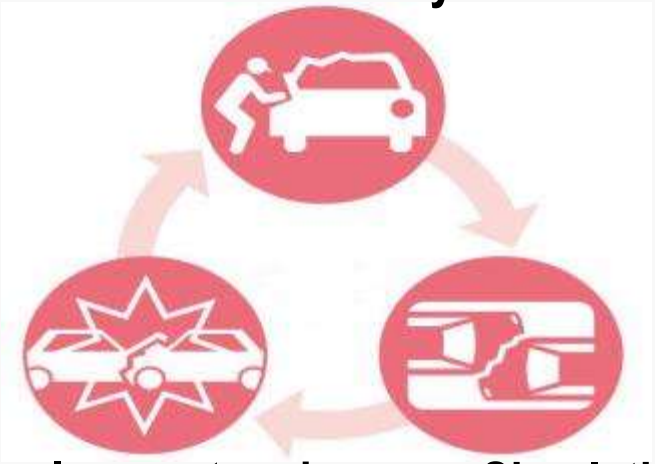


Approach to Safety

Integration of three elements



Pursuit of real-world safety

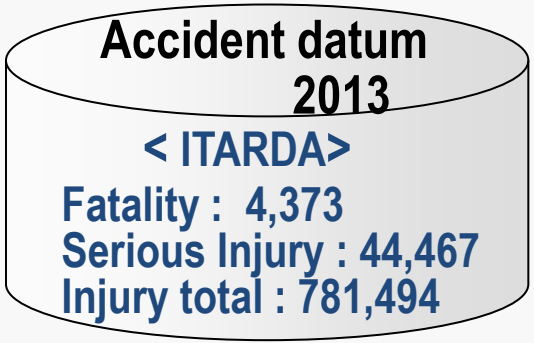


Accident Analysis

Purpose of accident patterns classification

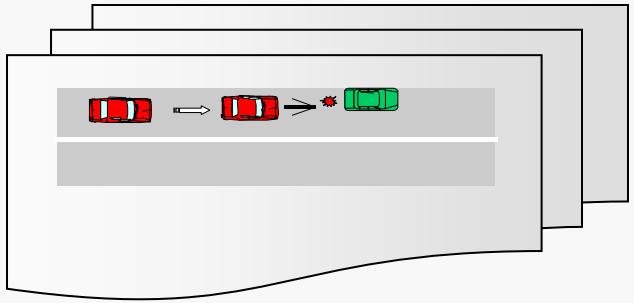
- To prioritize the measures which is effective for reducing traffic fatalities and injuries.
- Easy to understand the accident contents by the illustration of classification result.

ITARDA Macro database



Pattern classification

Accidental patterns

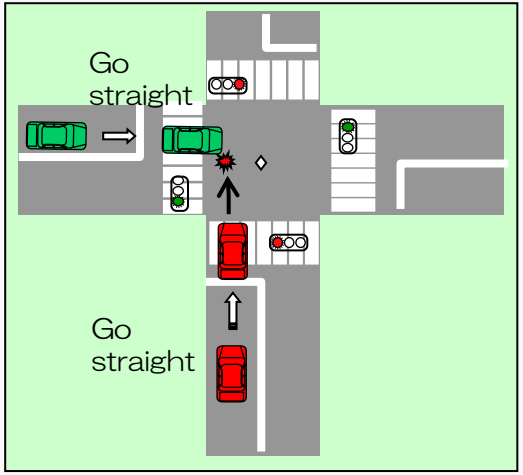


(Approximately 250patterns)

Accident Analysis

Ⅰ An Example of accidental patterns

Pattern **No.**	CTC－15
Accident Category	Public road　Vehicle to Vehicle　Crossing
Accident Situation	In the intersection, going straight at red signal Collide with the vehicle coming from left side
Related person	Guilty side:　Ped.　Cyclist　2Wheeler(50cc・Bike)　Vehicle Victim side:　Ped.　Cyclist　2Wheeler(50cc・Bike)　Vehicle　Single
Place	Route　Public road　Highway Place　Intersection　Near Intersection　Curve　Bridge/Tunnel　Straight　Others Traffic regulation：　Signal　None
Accident category	Vehicle to Vehicle　Crossing
Behavior	Guilty side　Go straight　Lane change　Right turn　Left turn　Passing　Back　Others
Positioning	Victim side　Opposite　Left　Right　Same　Others



Ⅱ More detail information about the accidents

- **With / without Median**
  - **Day or night**
    - **Weather**
      - **Surface condition**
        - **Traffic Violation**
          - **Velocity**
            - **Human factor (Miss Acknowledge・Judgment・Operation)**

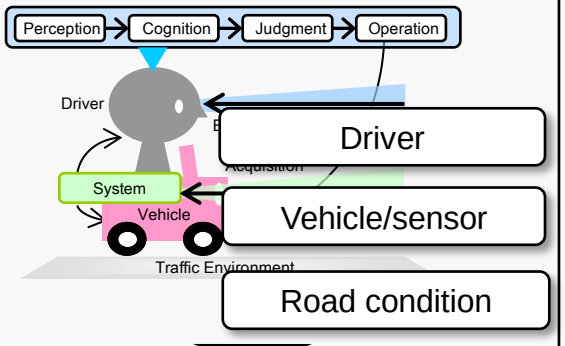
Simulation for an effectiveness evaluation

Accidental data

Experimental data

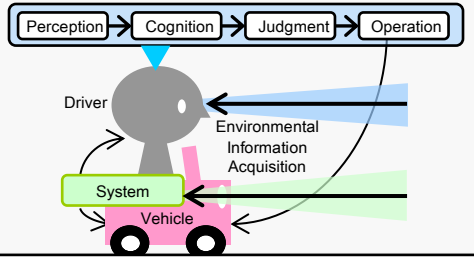
Data from papers

Simulated Accidental scene (without systems)



To simulate an accidental scene by considering accident root causes

Simulated Accidental scene (with systems)



Active Safety systems

Driver response to the safety systems

Response time and avoidance reactions by driver conditions(cognitive, drowsiness)

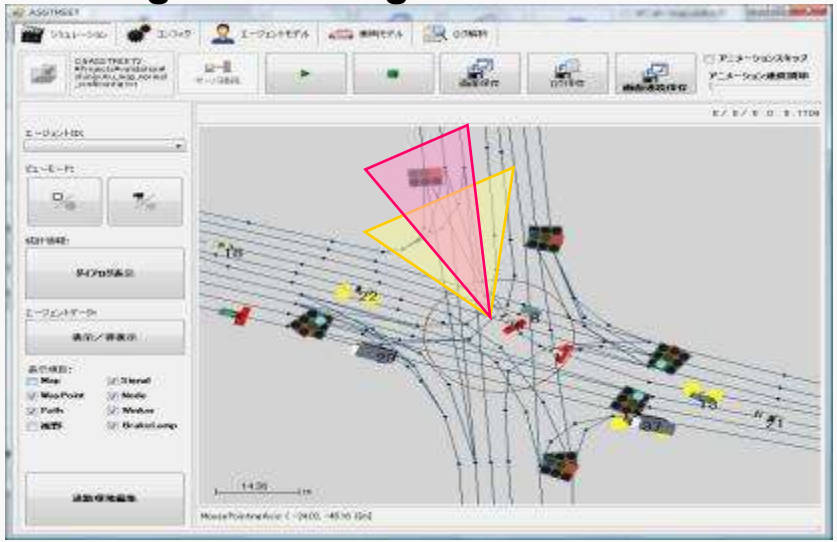
Experimental data

Effectiveness of traffic accident reduction by active safety systems

Driver Model

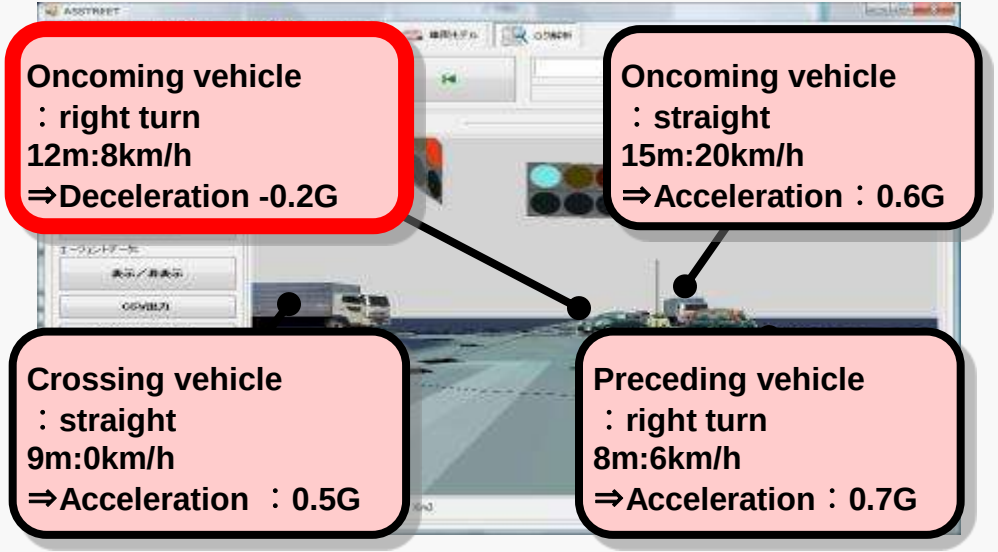
■Driver model based on Recognition⇒Judgment⇒Operation cycle

Simulating drivers' sight and flash memories



Judging by cognitive information

Dynamic condition of each objects



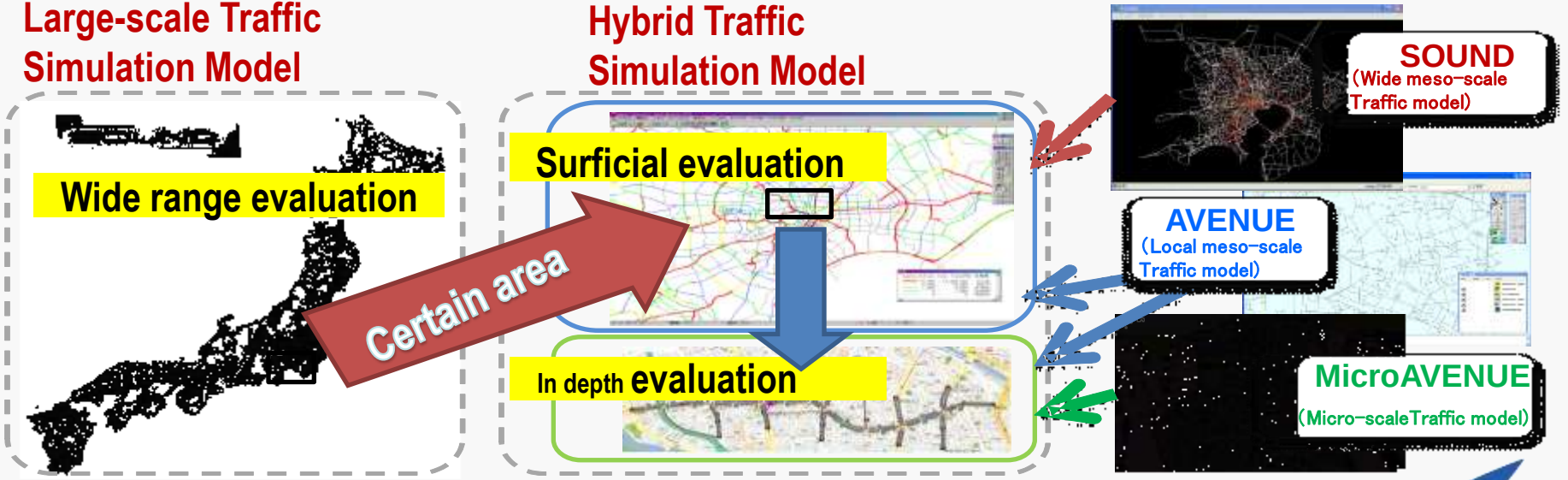
Establish thousands of logic by each situations

By defining a distribution of drivers behavior properties,
individual difference can be described.
（Oversight, Blind spot, Misrecognition, Misjudgment, Mis-operation. etc.）

Emission model; Traffic Simulation

Goal To recreate various traffic situation from nation wide to local route with Appropriate models

Point **Hybrid Simulation** Various kind of simulation models link together consecutively with common network datum, OD traffic and parameters.



Conclusion

- Main purpose of SIP Automated driving system is to reduce traffic accident fatalities and CO2 emission.
- For this purpose, a simulation methodology which can evaluate effectiveness of each measure will be developed in this project.
- PDCA cycle will be practiced by adopting those simulation model in some selected cities.

Thank you!