

# Humans and Automated Driving Systems

**Human error and performance are two side of the same coin**

**October 28, 2015**

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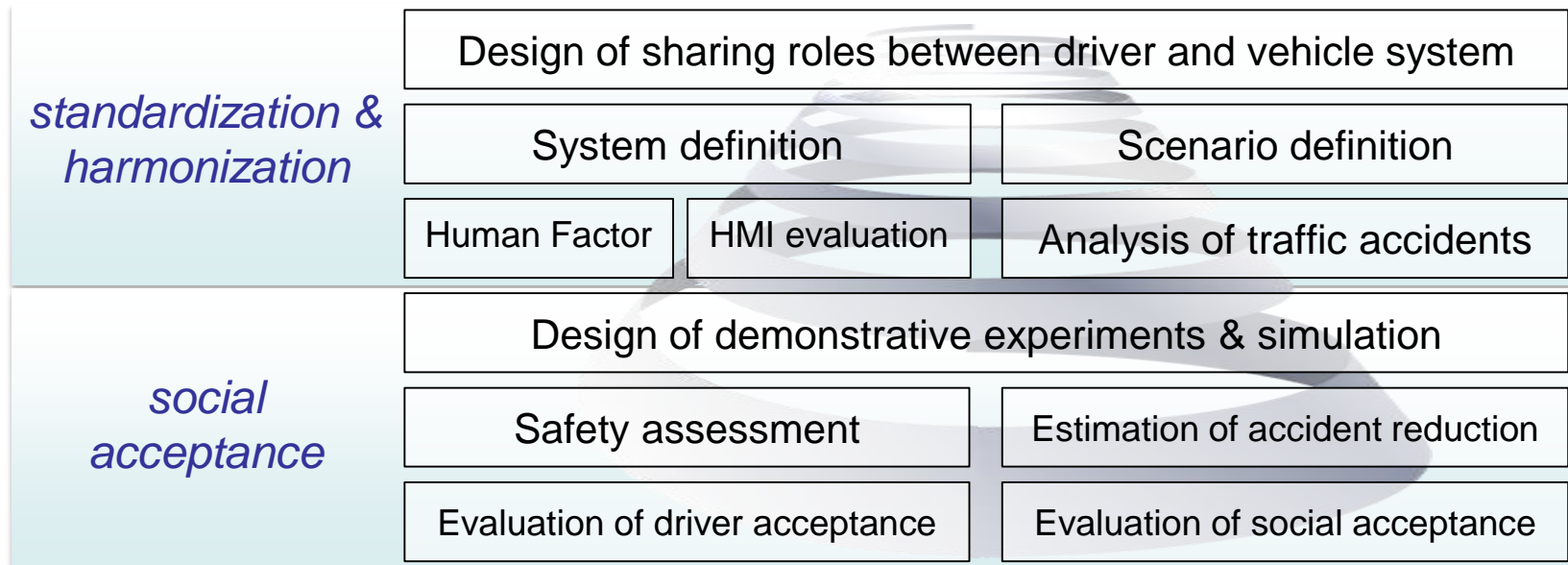
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# SIP activities for Human Factors

## ■ 3 Phase for challenges and approaches

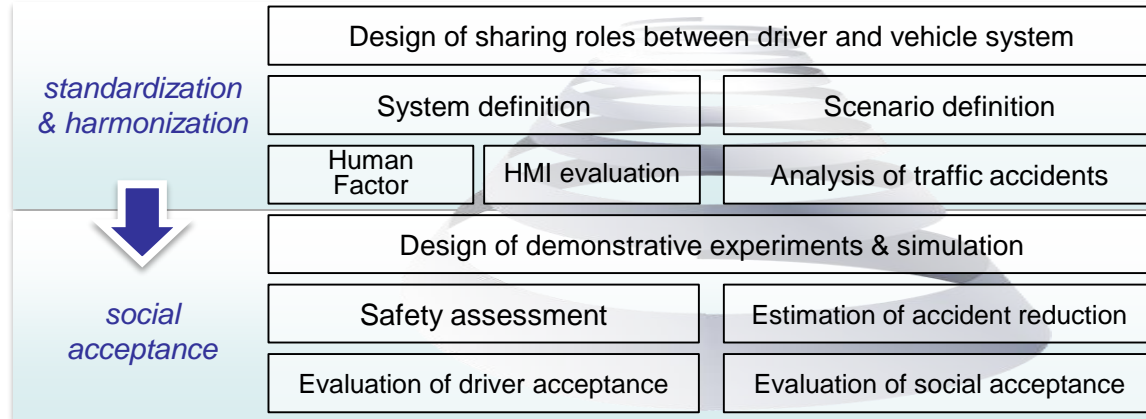
- Systems & Humans
- Systems & Other Traffic Participants
- Systems & Society

## ■ Framework

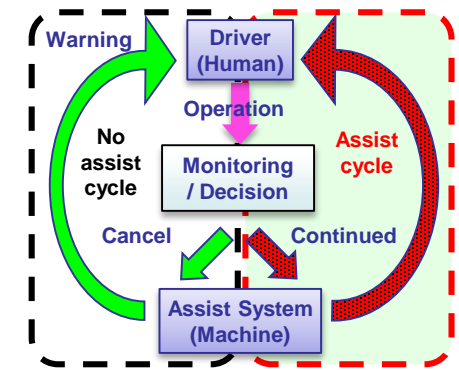


# Summary of SIP activities in 2014

## ■ Activities and Framework



## ■ Starting point



Extend the concept of Lv2 Human Centered Automation

## ■ Systems and Humans

Human-out-of-the-loop/-in-the-loop

- SAE Level 3
- Conditional Automation



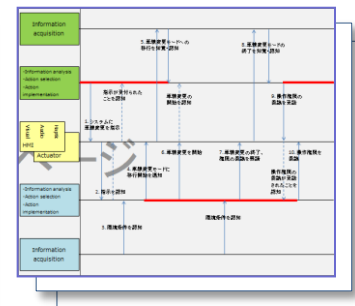
Human-in-the-loop

- SAE Level 2
- Partial Automation

## ■ Scenario / Situation / Use case



## ■ Modeling and Analysis



Timeline of Human Machine Interaction



Research Questions

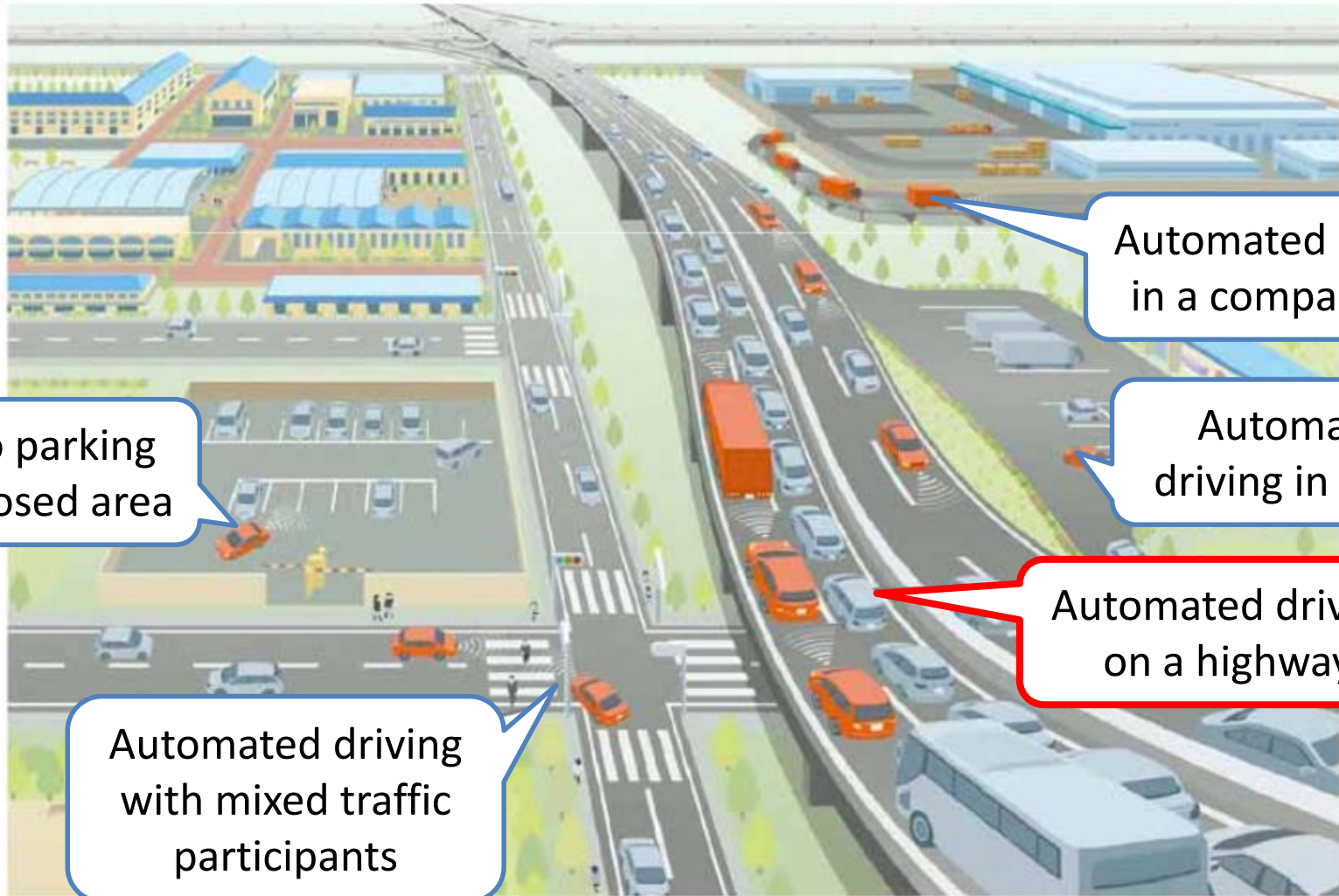
# Activities in 2014

- 3 Phase of challenges and approaches
  - **Systems & Humans**
  - Systems & Other Traffic Participants
  - Systems & Society

<i>standardization &amp; harmonization</i>	Design of sharing roles between driver and vehicle system		
	System definition		Scenario definition
	Human Factor	HMI evaluation	Analysis of traffic accidents
<i>social acceptance</i>	Design of demonstrative experiments & simulation		
	Safety assessment		Estimation of accident reduction
	Evaluation of driver acceptance		Evaluation of social acceptance

# Systems & Humans

## ■ 1<sup>st</sup> : Scenario



Auto parking  
in closed area

Automated driving  
in a compact city

Automated  
driving in SA/PA

Automated driving  
on a highway

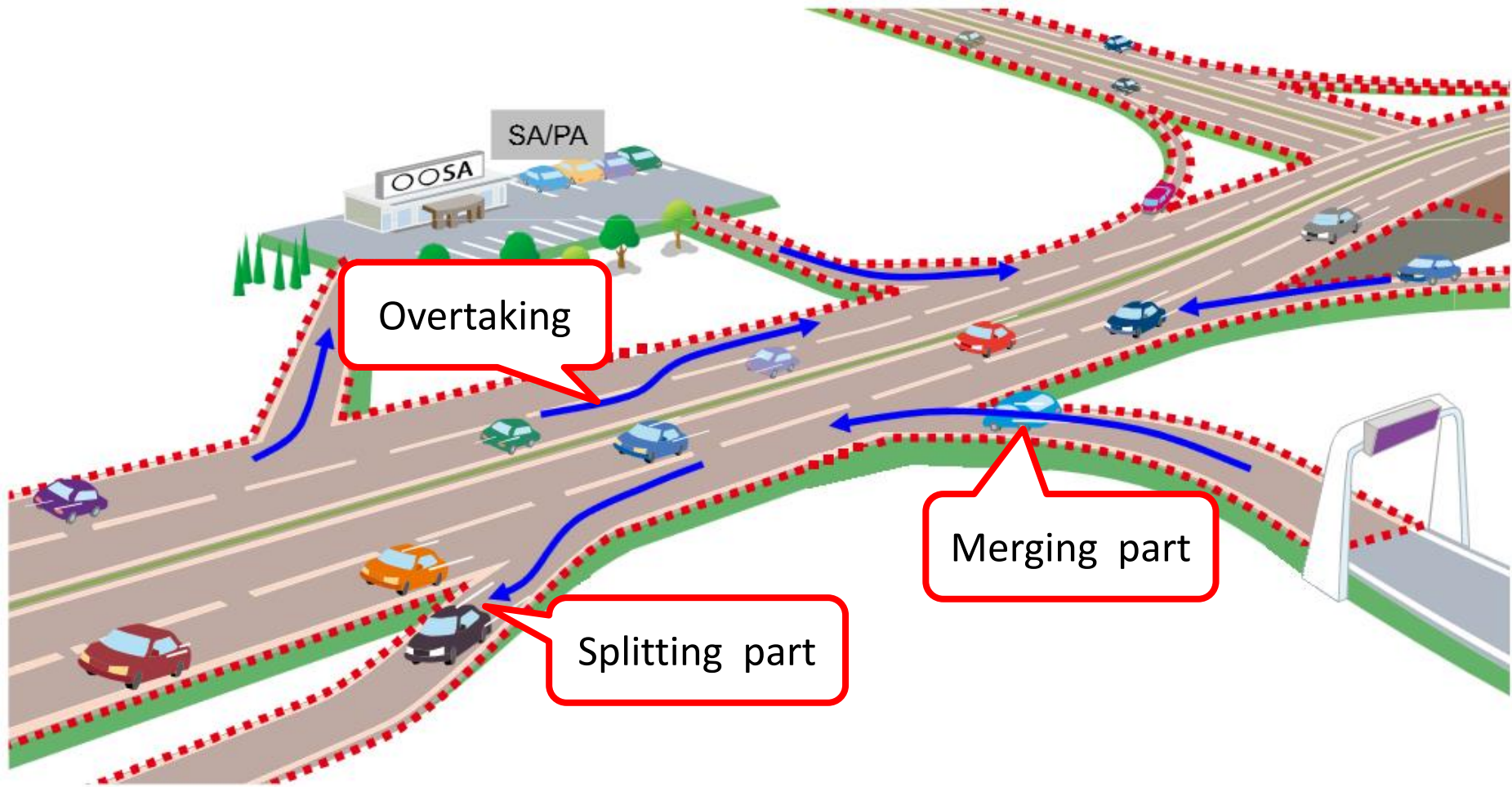
Automated driving  
with mixed traffic  
participants

Source: MLIT Autopilot Research Council 6<sup>th</sup> Report in 28 Oct 2013

<http://www.mlit.go.jp/road/ir/ir-council/autopilot/pdf/06/5.pdf>

# Systems & Humans

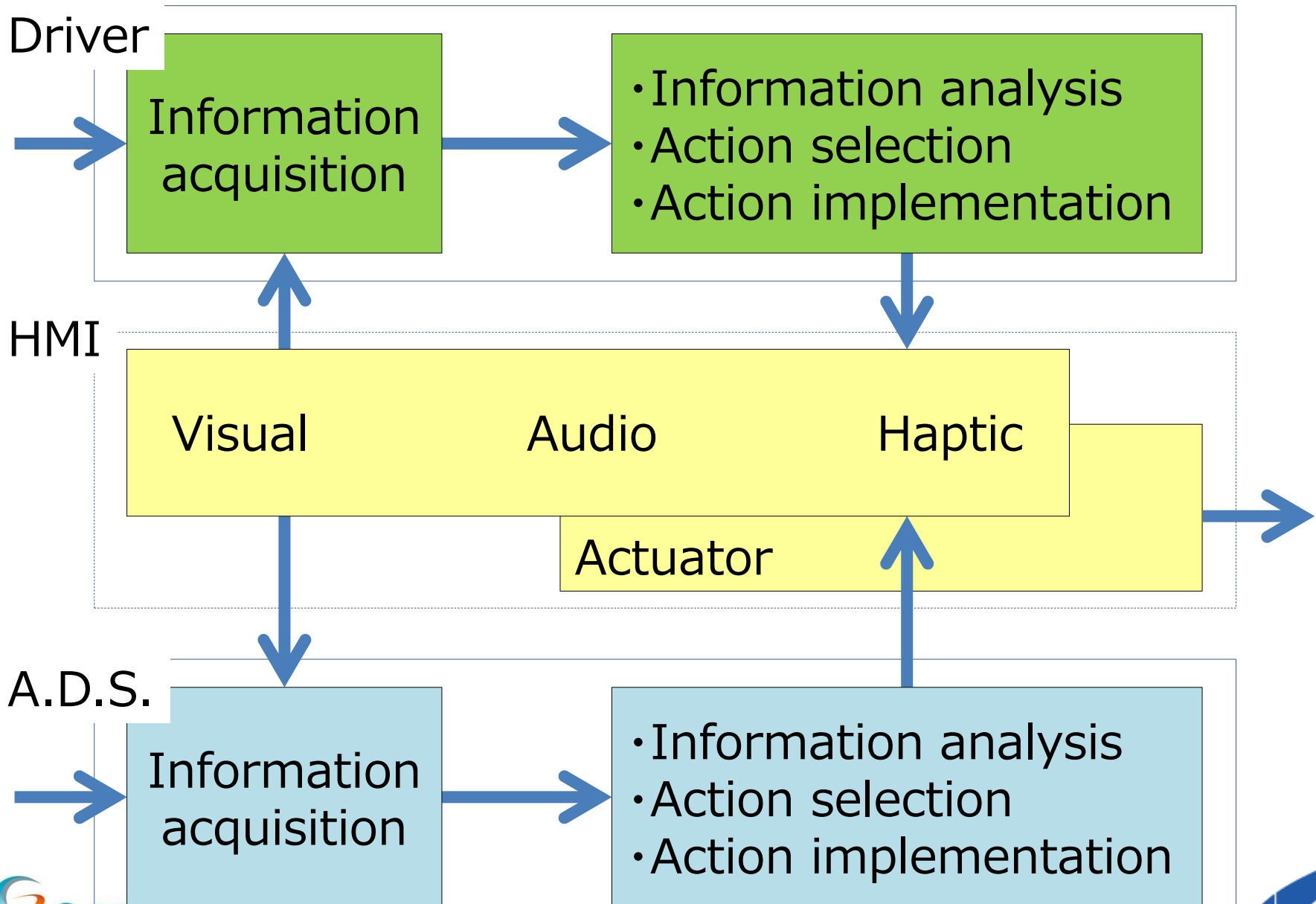
## ■ 2<sup>nd</sup> : Situation



Source: MLIT Autopilot Research Council 6<sup>th</sup> Report in 28 Oct 2013

<http://www.mlit.go.jp/road/ir/ir-council/autopilot/pdf/06/5.pdf>

# 3rd : Modeling - “Driver - System Interaction”





# 4th : Analysis - Example: "Automated Lane Change"

Driver

## Timeline of Human Machine Interaction

*t*

Information acquisition

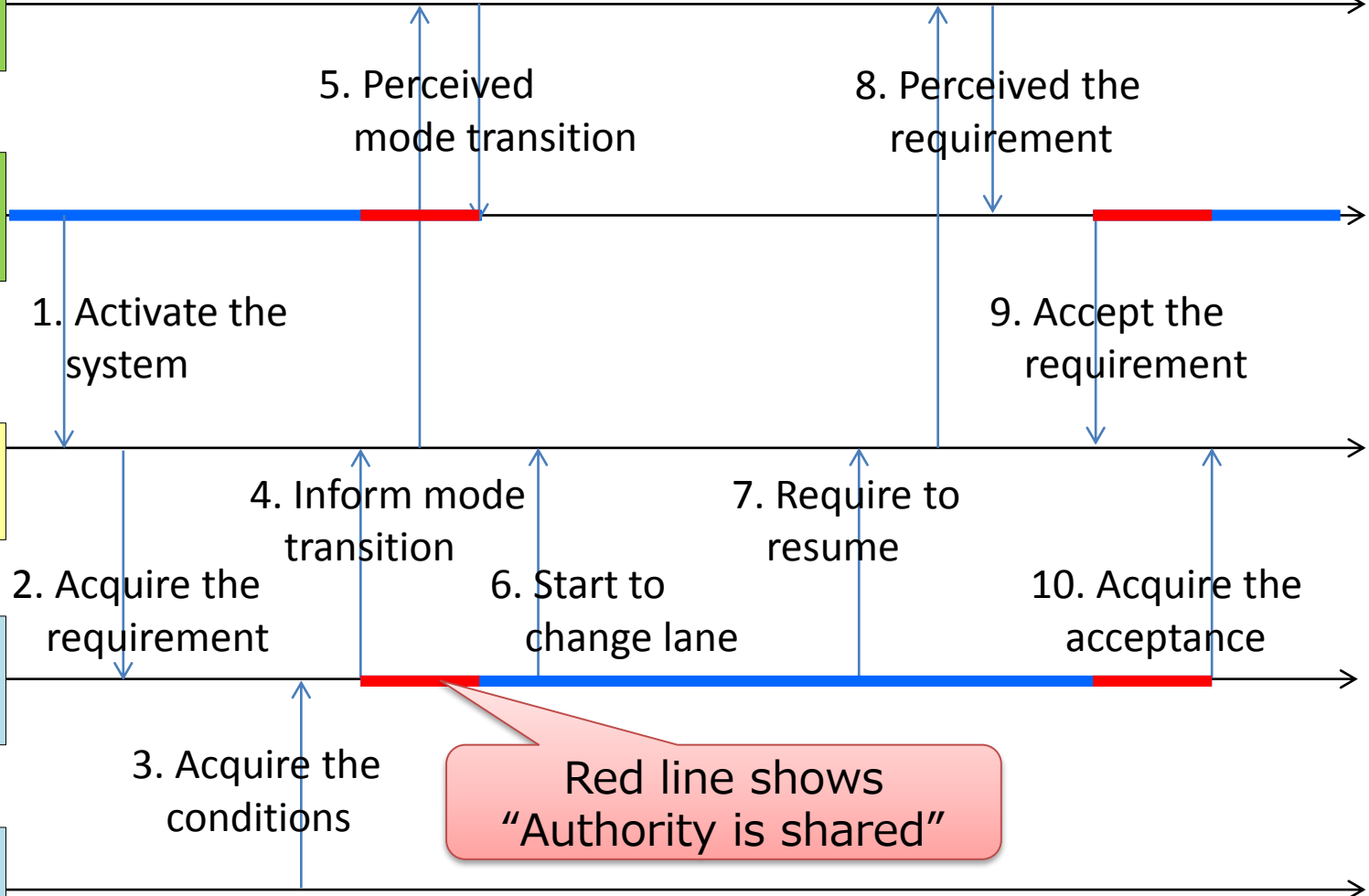
• Information analysis  
• Action selection  
• Action implementation

Visual  
Audio  
Haptic  
HMI

Actuator

• Information analysis  
• Action selection  
• Action implementation

Information acquisition



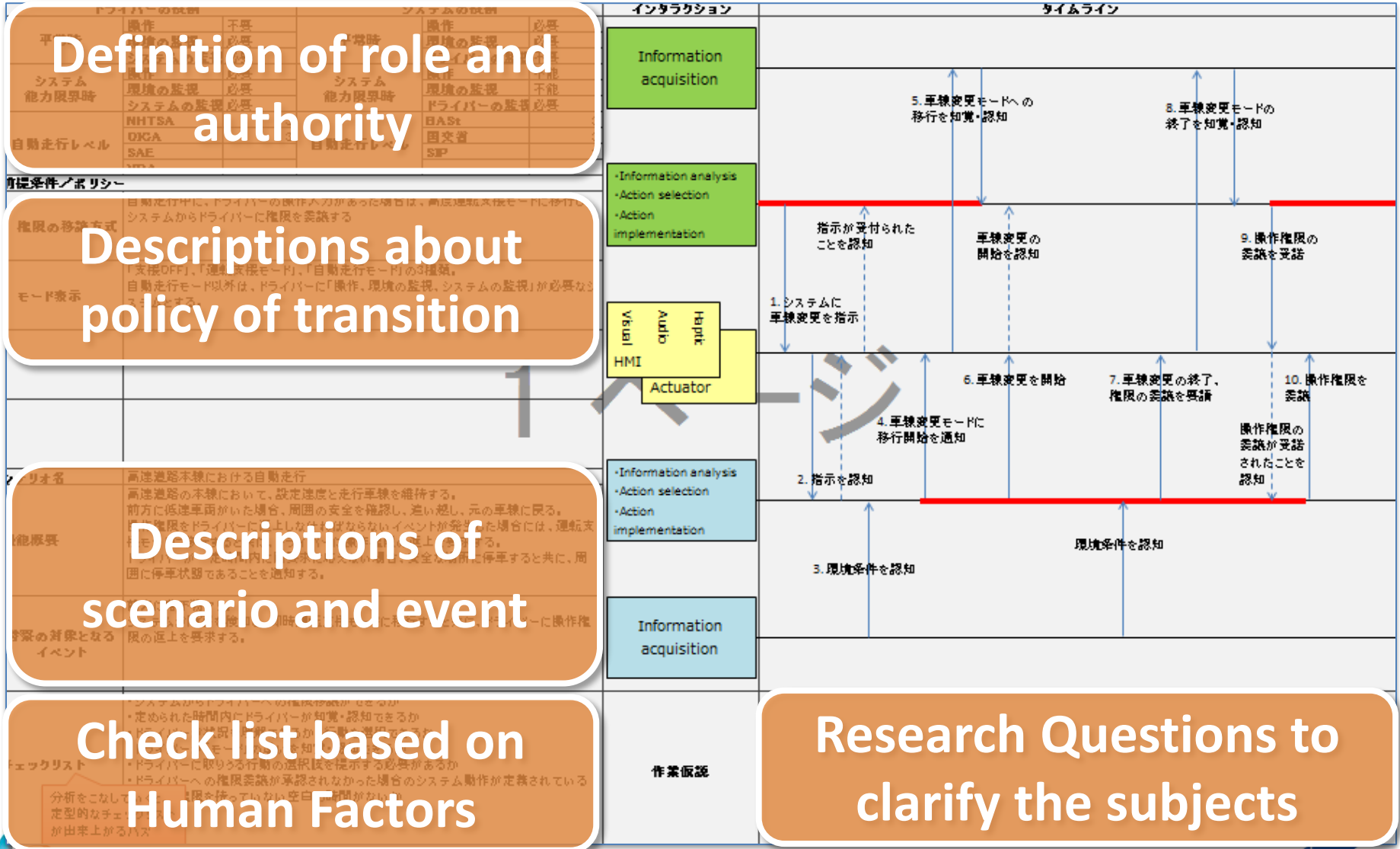
Research Questions:

Should the driver respond acknowledgement to the system?

...

# 4th : Analysis - Example: "Automated Lane Change"

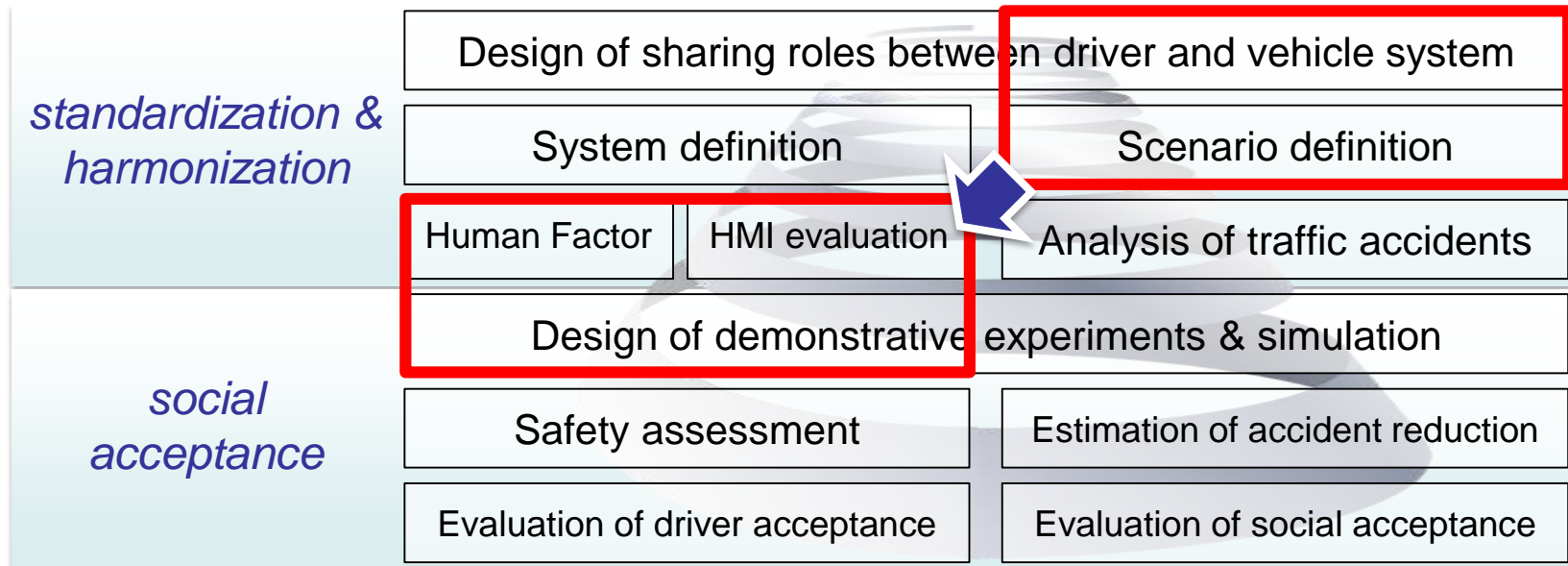
## A complete view of the chart



# Action plan in 2015

## ■ Experiment on Driving Simulator

- Target: Lv2 and Lv3 system
- Scenario: Automatic Lane Change / Merge Traffic
- Expected: Time of “Transition” or “Shared Control”



# Focusing point in 2015

## ■ Challenges for Lv3 AD

- Whatever the “Transition time” will be, Lv3 AD still need to have performance against the worst cases?
- How can we get the evidence for feasibility of Lv3 AD?

### Nourishment of social acceptance

*OEM / Supplier*

- Functions, Benefit
- Definition of the roll of a driver

*Customer*

- Expectations
- Understanding of the role of a driver

### Minimization new risks due to automation

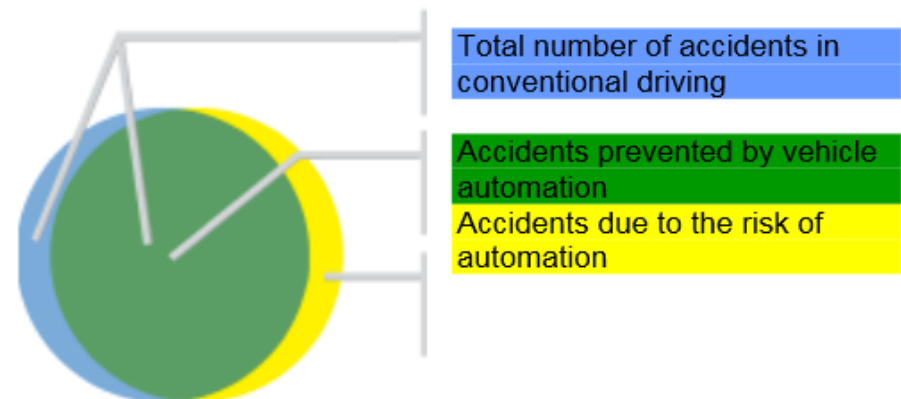


Fig. 4-1: Theoretical potential for accident prevention in vehicle automation (Source: project group)

Source: BAST study about the legal consequences of automation (Legal consequences of an increase in vehicle automation)

# Focusing point in 2015

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  - Systems & Other Traffic Participants
  - Systems & Society

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# System definition

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
<b>Human driver monitors the driving environment</b>						
<b>0</b>	<b>No Automation</b>	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
<b>1</b>	<b>Driver Assistance</b>	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
<b>2</b>	<b>Partial Automation</b>	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	<b>System</b>	Human driver	Human driver	Some driving modes
<b>Automated driving system ("system") monitors the driving environment</b>						
<b>3</b>	<b>Conditional Automation</b>	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the dynamic driving task with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	<b>System</b>	Human driver	Some driving modes
<b>4</b>	<b>High Automation</b>	the <i>driving mode</i> -specific performance by an automated driving system of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	<b>System</b>	Some driving modes
<b>5</b>	<b>Full Automation</b>	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	<b>All driving modes</b>

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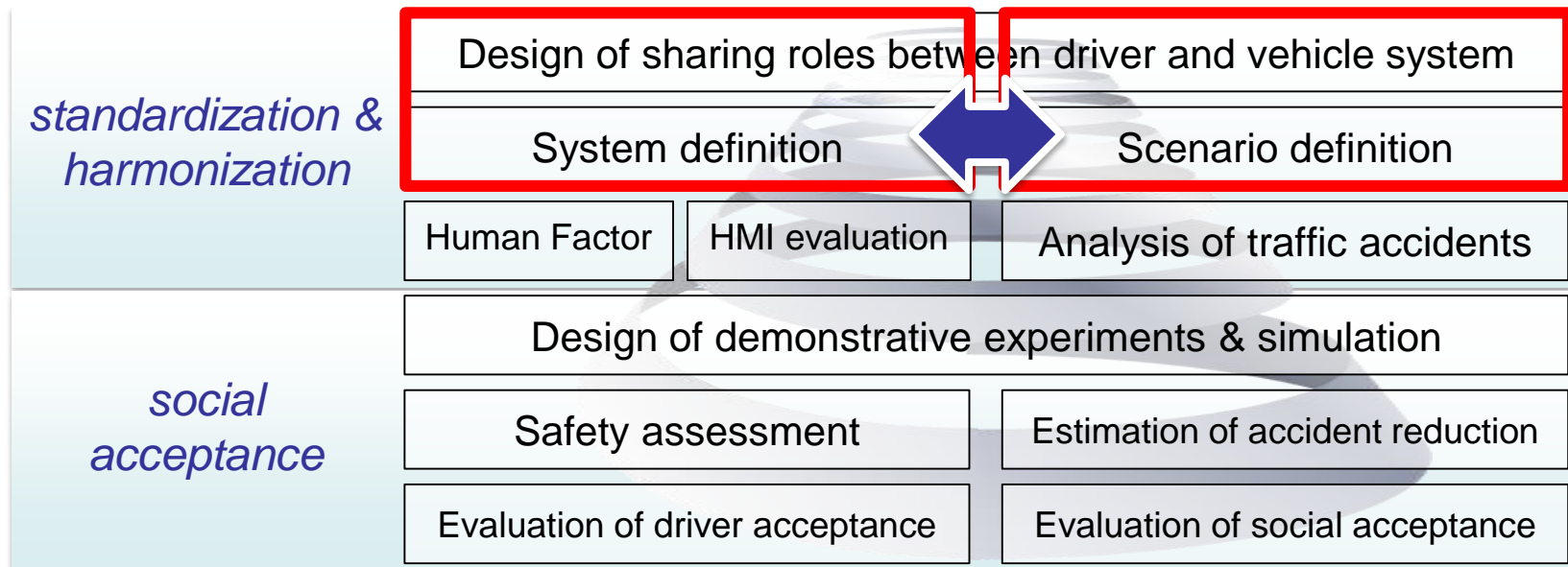


# System definition

## ■ A hypothesis

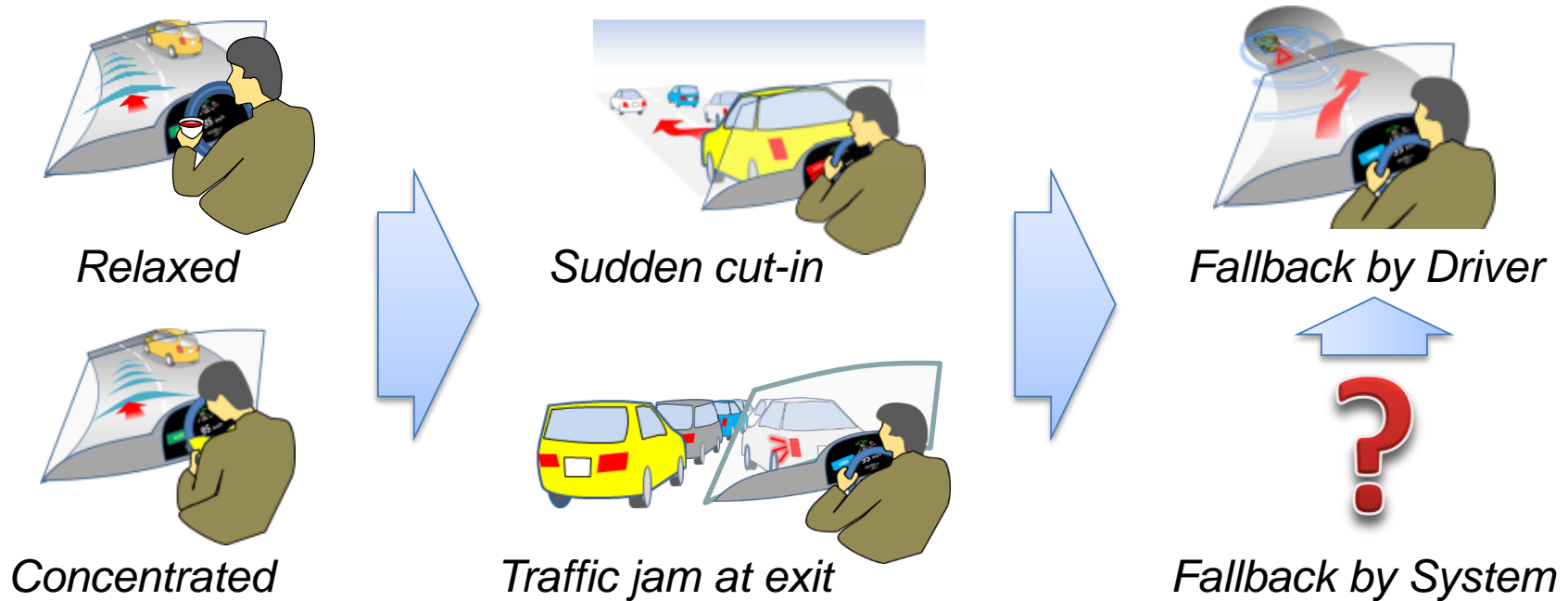
- The Lv3 system should have “Fallback performance of dynamic driving task”.
- What’s “Fallback performance”? → We should back to the scenario definition.

## ■ Framework



# System definition

## Scenario



## Research Questions for the next step

- *What's the worst case at given condition?*
- *What's the "fallback performance" for the driver?*
- *What kind of fallback action should the system have?*
- *How to make a smooth transition from System to Driver?*

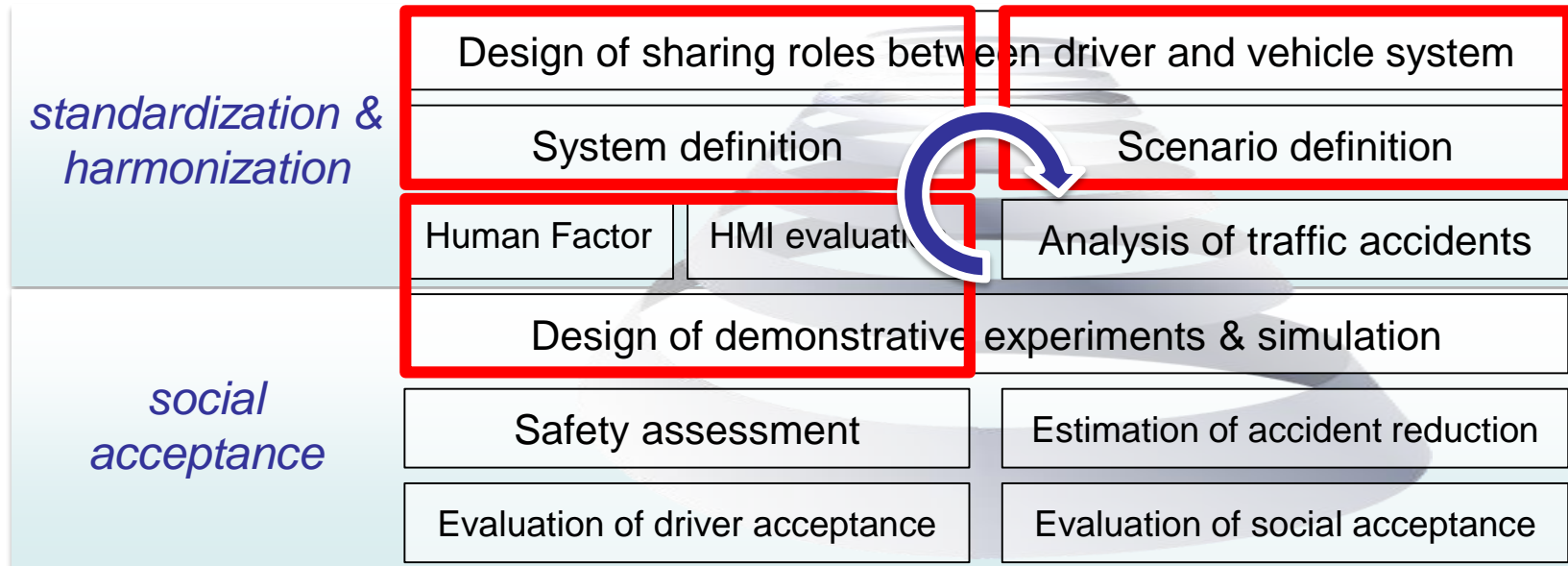
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# Next Step

## ■ More research questions

- Not only for the vehicle technologies but also some requirements to the infrastructure.
- Then, we should design test plan for the driving simulator experiments form the HF points of view.

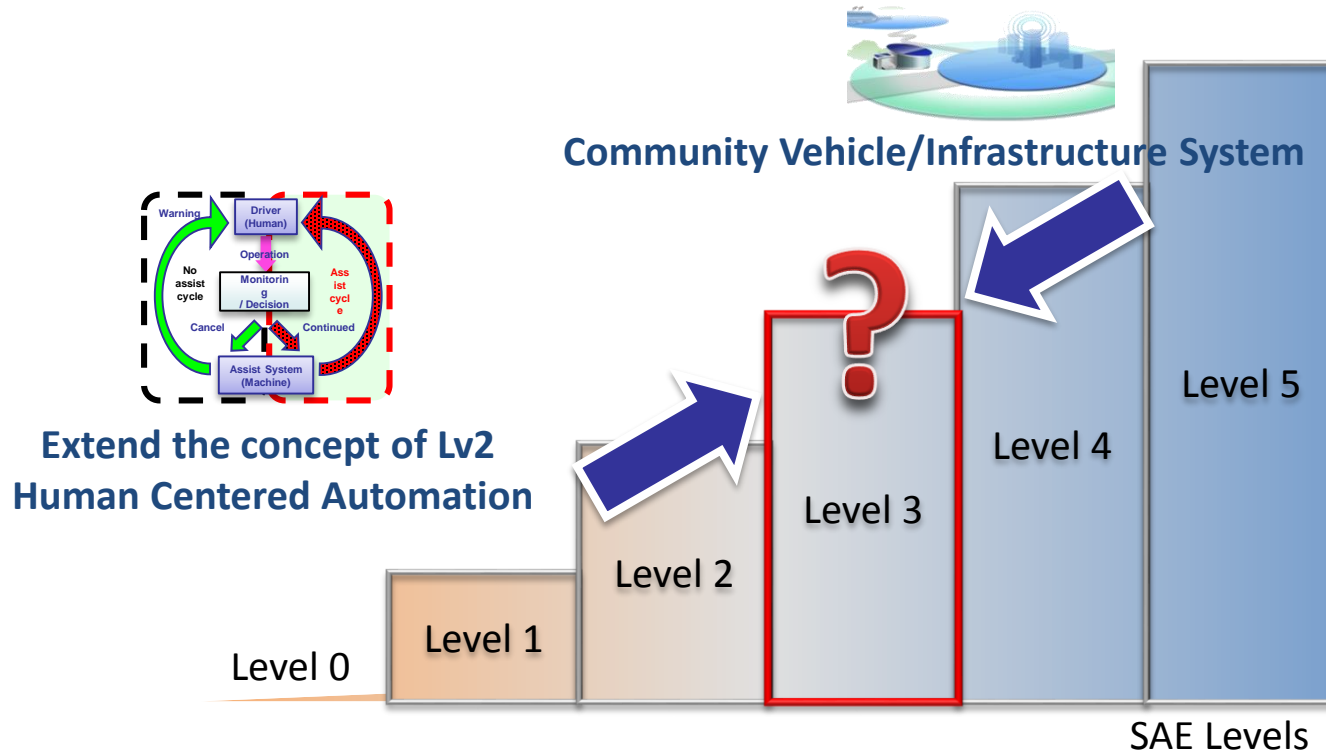
## ■ Framework



# Conclusion

## ■ Challenges for Lv3 AD

- Dig into the “Fallback performance”.
- More research questions from the view point of Human Factors
- Another approach - “Lv4 → Lv3”



**Thank you for your attention.**

**END**