Diffusion of Automated Driving

Research Results of
CADIA, Japanese-German Research Co-operation on Connected and Automated Driving

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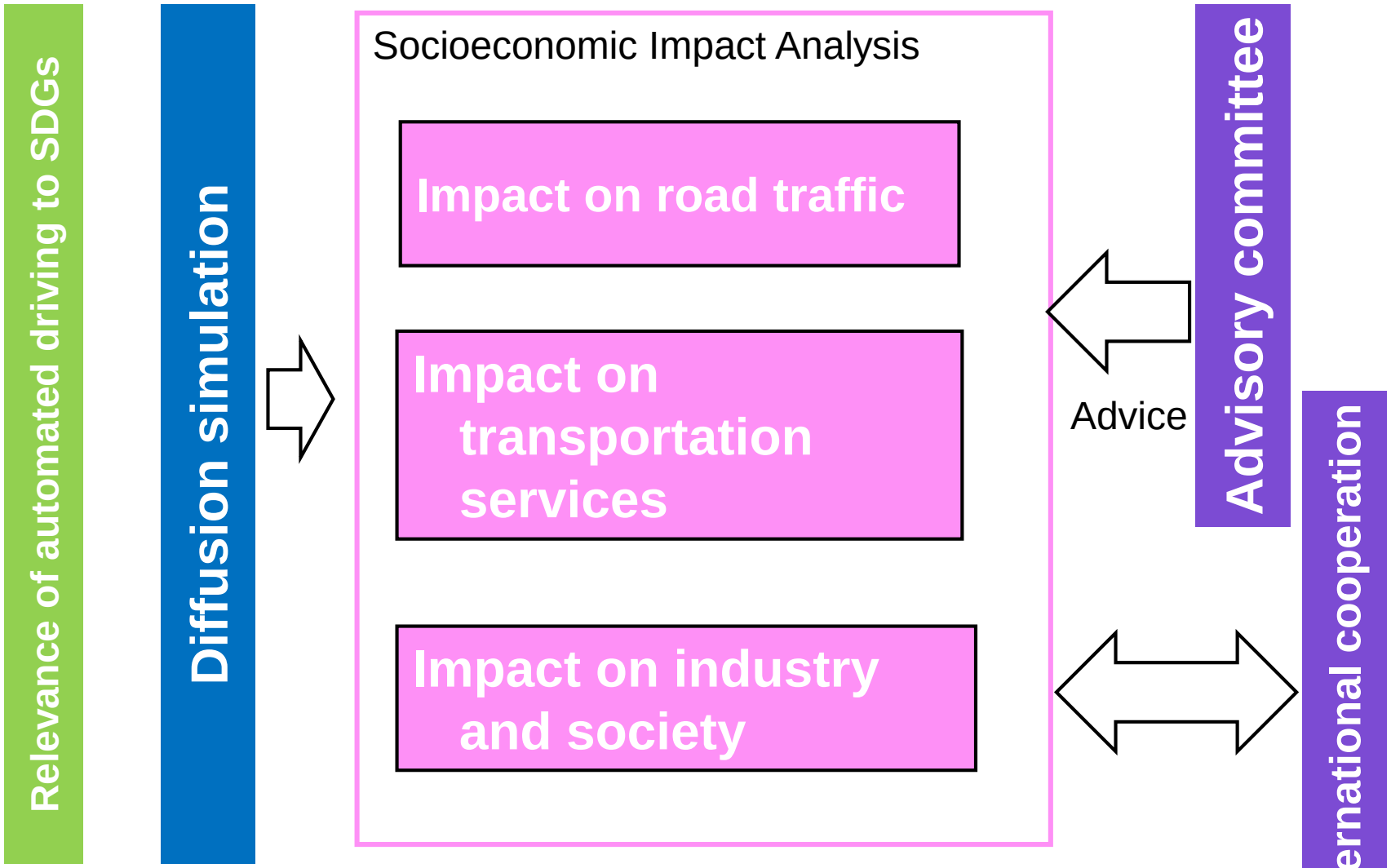
Hiroaki Miyoshi, Doshisha University
Shoji Watanabe, Doshisha University
Masanobu Kii, Kagawa University

Note

Doshisha University and the University of Tokyo are currently in the process of redesigning our simulation and evaluation model including parameter setting.

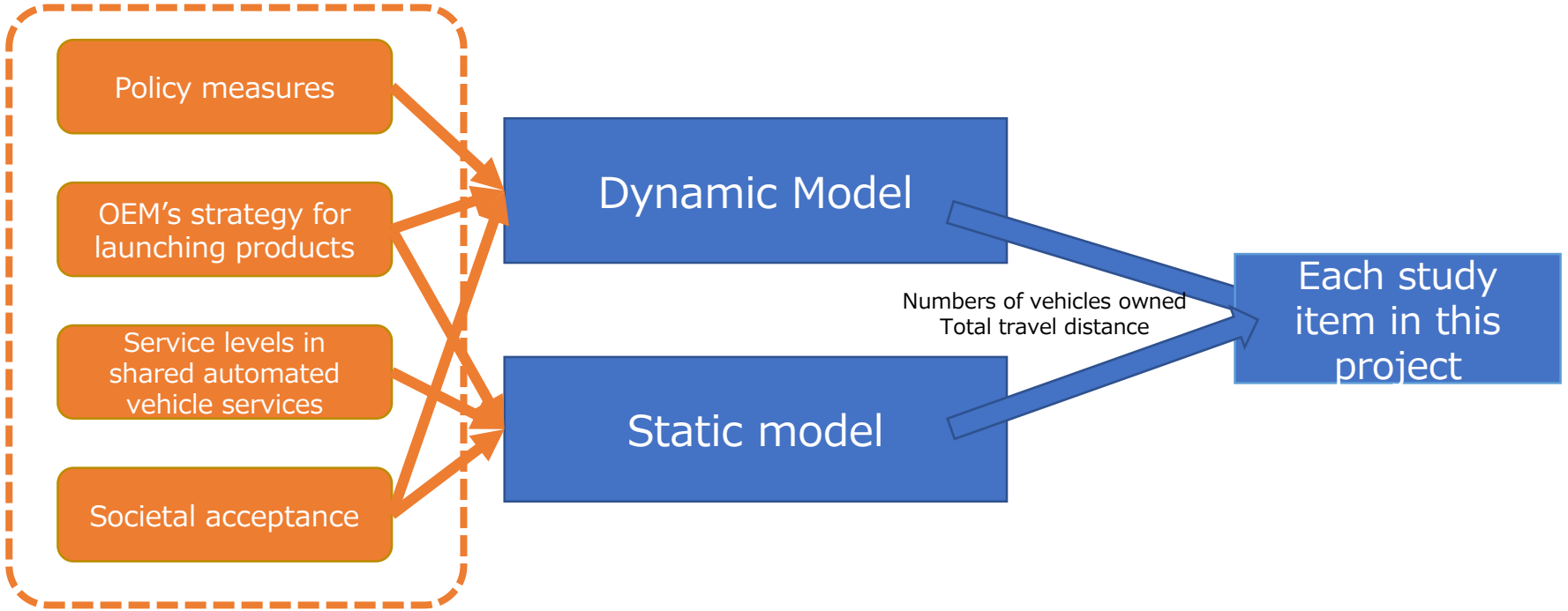
The model formulation and simulation results presented in this presentation pertain to the previous version of the model, and thus do not represent the final conclusions of our project or the official view of SIP-adus.



Source: Fig. 1 of Suda and Miyoshi (2021)

Purpose of Diffusion Simulation

- Simulation results are used as common data for various impact assessments in the project.
- Impacts from the following factors on market diffusion of automated vehicles can be evaluated:
  - Policy measures（economic incentives, mandatory installation of automated-driving devices),
  - OEM's strategy for launching products (when to launch into markets, at what price),
  - Service levels in shared automated vehicle services（usage fee, wait time）,
  - Enhancement of societal acceptance.



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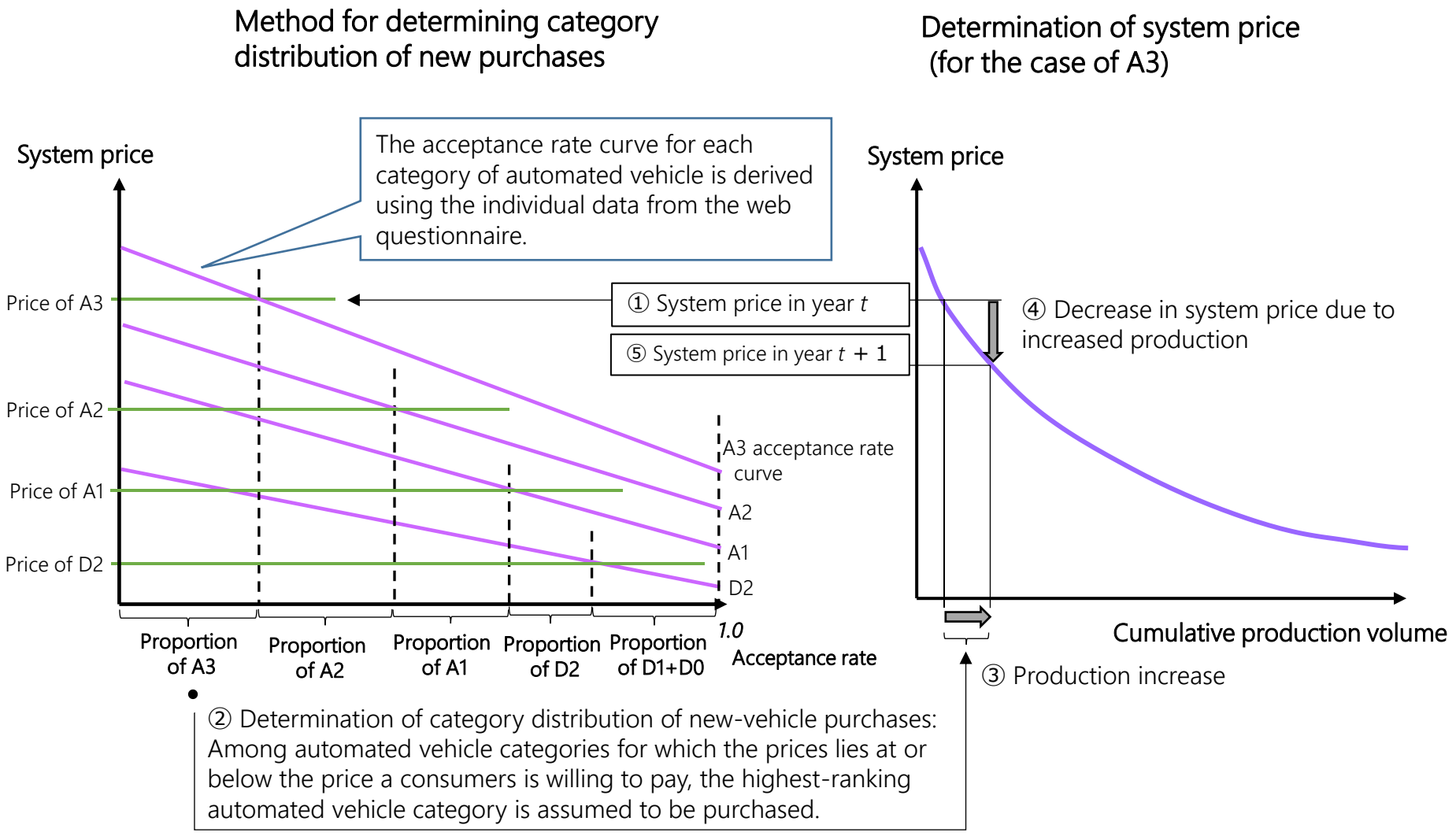
Categories of Automated Vehicles

Category	Highways	General roads	Dynamic model	Static model
Advanced Driver Assistance System				
D0	SAE Lv. 1 or less	SAE Lv. 1 or less	✔	
D1	SAE Lv. 1 Driver assistance	SAE Lv. 1	✔	
D2	SAE Lv. 2 Partial automation	SAE Lv. 1	✔	
D3	SAE Lv. 2 Partial automation	SAE Lv. 2		✔
Automated Driving System				
A1	SAE Lv. 3 Conditional automation	SAE Lv. 2	✔	
A2	SAE Lv. 4 High automation	SAE Lv. 3 on major arteries and thoroughfares	✔	
A3	SAE Lv. 4 High automation	SAE Lv. 4 on major arteries and thoroughfares	✔	
A4	Driveress vehicle equivalent to SAE Lv. 4 or 5			✔

Source: Based on Table 1 of Suda and Miyoshi (2021) with revised category names and other changes.

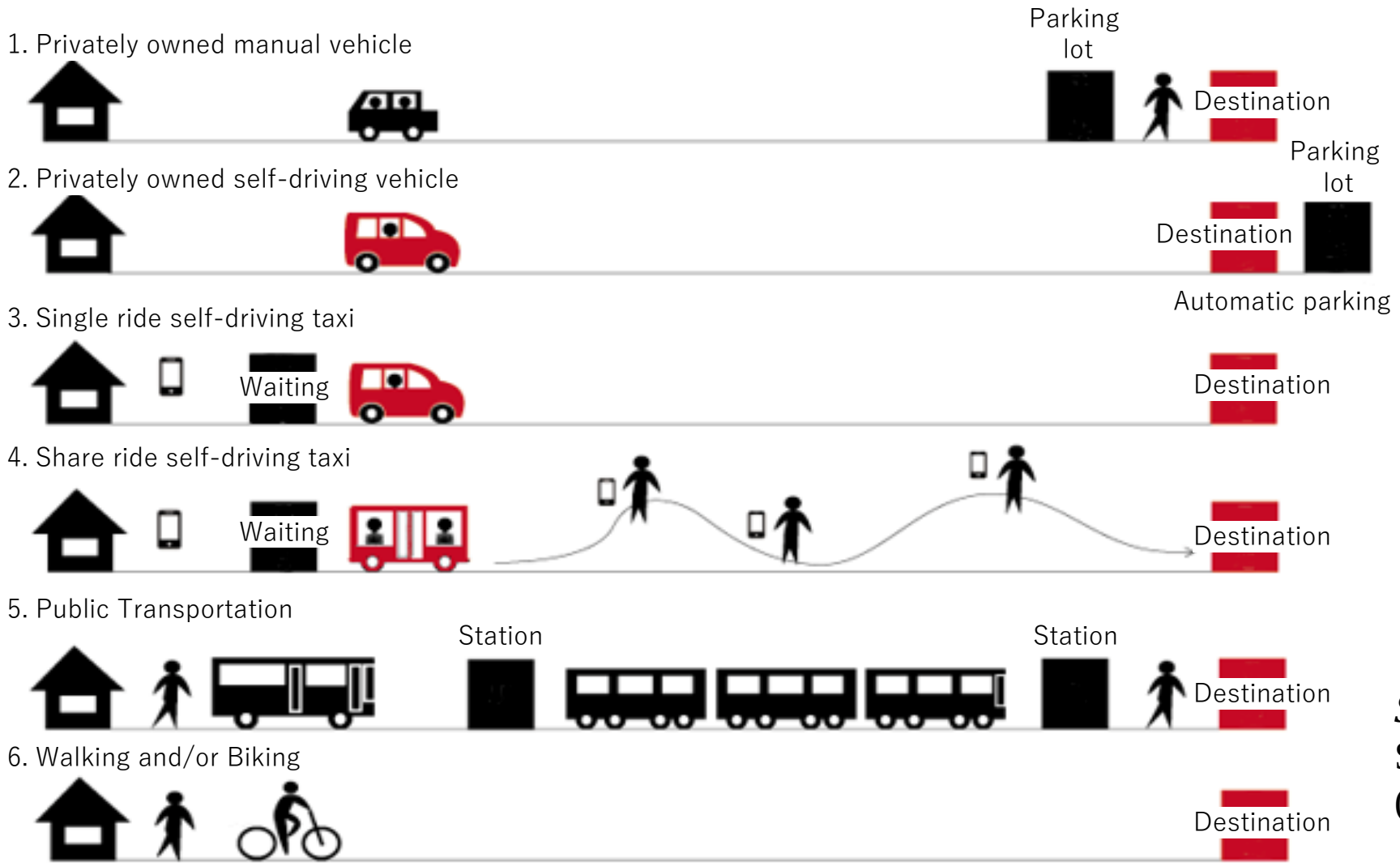
Structure of Dynamic Model



Source: Based on Fig. 2 of Suda and Miyoshi (2021) with revised category names and other changes.

Static Model

The static model estimates how car ownership and usage will be in a society where driverless automated vehicles (equivalent to SAE levels 4 or 5) are implemented.
The following six types of transportation modes are assumed to be available to consumer.

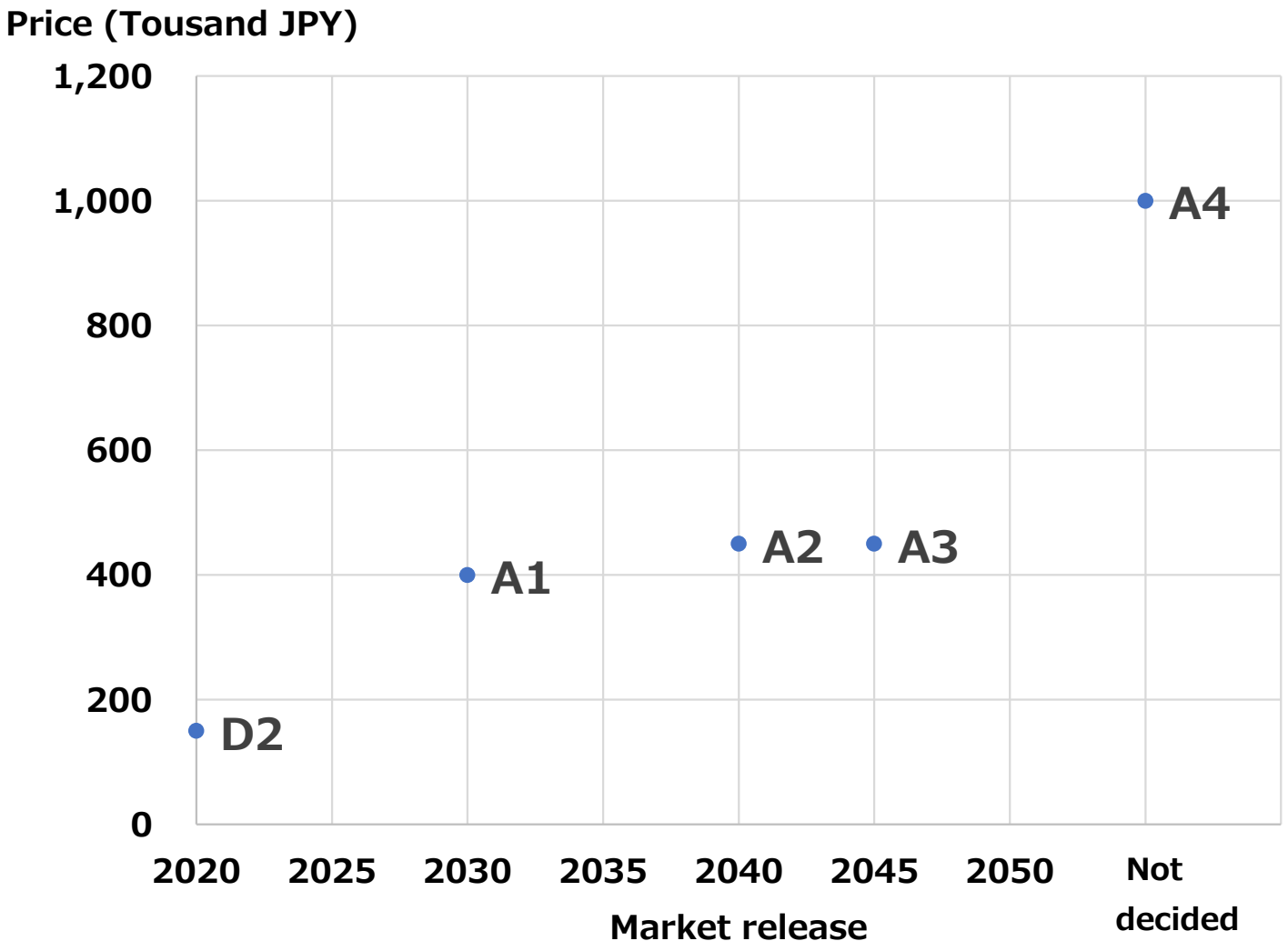


Source: Fig. 3 of Suda and Miyoshi (2021)

I Two Types of Diffusion Simulation Model —Dynamic and Static

II Sensitivity Analysis Using Dynamic Model

Major Assumption (Price and Market Release)



Scenarios

Scenario (1) 50% decrease in initial retail prices (including subsidization)

Scenario (2) Increase in consumer expectations regarding the benefit they themselves will derive from automated driving

(Average: 20.5 ⇒ 80th percentile: 24.0)

Scenario (3) Increase in consumer expectations regarding the benefit they themselves will derive from automated driving

(Average: 20.5 ⇒ 80th percentile: 24.0)

&

Increase in consumer expectations regarding the benefit to society from automated driving

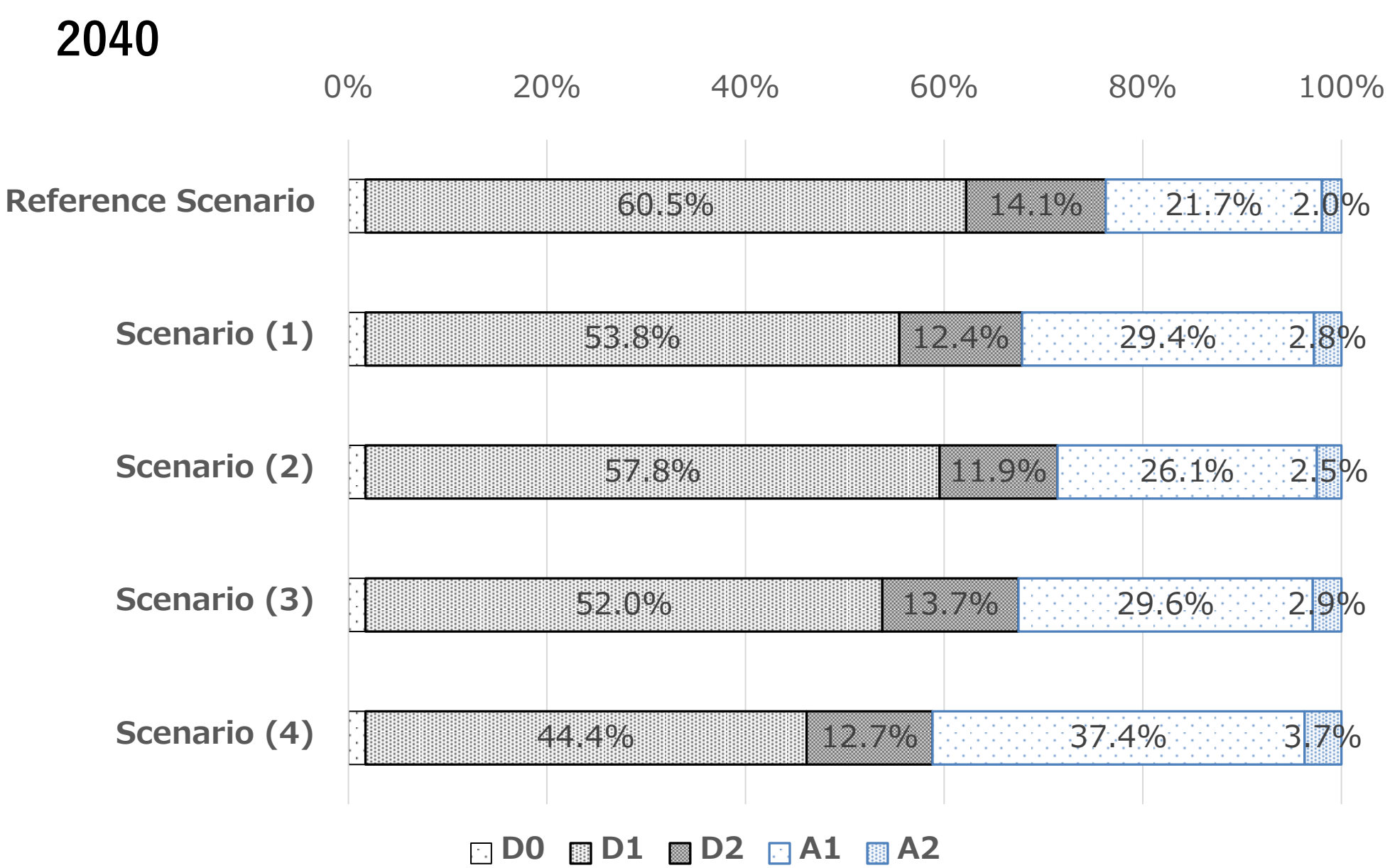
(Average: 25.0 ⇒ 80th percentile: 30.0)

Scenario (4) scenarios (1), and (3) simultaneously

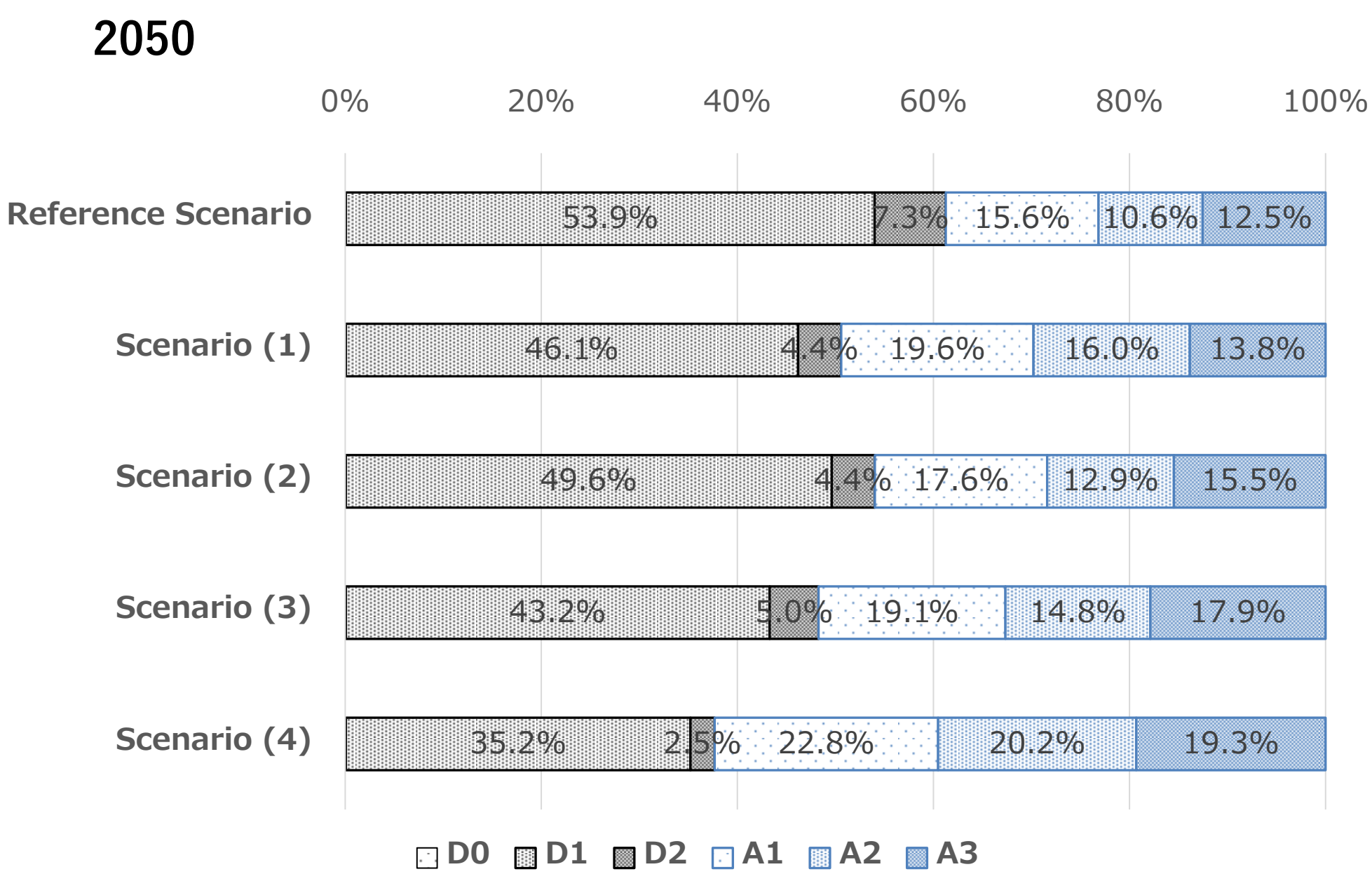
Benefits to individuals
Increasing opportunities for trips like shopping, leisure activities, and hobby projects
Increasing opportunities to visit friends, acquaintances, family, and relatives
Reducing burdens on drivers of personal vehicles
Making use of time spent traveling
Being able to call vehicles from other locations
Eliminating the need to worry about parking during trips
Benefito to Society
Rducing or eliminating traffic congestion
Reducing traffic accidents
Reducing environmental burden
Assisting mobility for older adults and some others
Alternative transportation for public transit networks in depopulated regions
Alleviating the shortage of truck bus, and taxi drivers
Spurring economic activity and international competitiveness

Our online questionnaires asked respondents to rate their expectations, on a scale from 1 (no expectations) to 5 (high expectations), of 13 potential benefits of automated driving, including 6 benefits to individuals and 7 benefits to society as shown in this Table. Total expectation scores for the 6 personal benefits and the 7 societal benefits, averaged over all respondents, were 20.5 and 25.0 respectively.

Result of Analysis (1)



Result of Analysis (2)



Conclusions

Enhancement of consumers’ expectations will be crucial for ensuring the spread of automated vehicles in the future.

Reconstruction of Dynamic Model

New Categories of Automated Vehicles

New Stated Preference Survey was conducted.

Sensitivity analysis using new dynamic model shows similar results: Importance of enhancement of social acceptance and expectation for automated driving

References

Suda, Y. and H. Miyoshi (2021), ”Development of Assessment Methodology for Socioeconomic Impacts of Automated Driving Including Traffic Accident Reduction*“, SIP 2nd Phase: Automated Driving for Universal Services-Mid-Term Results Report (2018-2020)*, pp.136-141

Acknowledgement

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We received the gracious permission of Ayako Taniguchi of University of Tsukuba to use, with partial modifications, surveys she had previously prepared. We take this opportunity to extend our gratitude to Professor Taniguchi.

Thank you for your kind attention