



Day 2

Socio-economic impact of CAD

Benefits of Automated Driving Systems : Traffic Accident Reduction

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Subject of Research

- **Technologies:** ADAS (Advanced Driver Assistance Systems) or Levels 1 and 2 Automated Driving Systems.
- **Benefits:** Reduction of traffic-accident losses through the use of the technologies.
- **Type of traffic-accident :** Accidents between four-wheeled vehicles.
- **Purpose:** Considering public policies that contribute to the diffusion of the technologies.



Classification of Economic Losses due to Road Traffic Accidents (1)

Monetary Losses

Personal losses: e.g., medical expenses and lost wage for missed work.

Material losses: e.g., damage to vehicles or structures requiring repairs.

Losses incurred by corporate entities: reduction of value-added due to missed work, death, residual disability.

Losses incurred by various public institutions: e.g. emergency transportation costs and costs of handling the accident by the police.

Source: Cabinet Office, Government of Japan (2012) (slightly modified and translated by author)



Classification of Economic Losses due to Road Traffic Accidents (2)

Non-monetary Losses

Physical or emotional suffering on the part of *victims* stemming from bodily harm or damage to material property.

Emotional pain and suffering experienced *by the families and friends of the victims*.

Psychological burdens experienced by *the persons responsible for causing the accident*, as well as their families and friends.

Source: Cabinet Office (2012) (slightly modified and translated by author)

Note: Second and third non-monetary losses are not included in our study.



Economic Losses for a Victim (at 2015 prices)

Thousand EUR (at the rate of 120 Japanese Yen to EUR; the same shall apply hereinafter)

	Death	Serious Injury	Slight Injury
Monetary Losses	259	80	13
Non-monetary losses	1,753	71	2
Total	2,012	150	15

- Source: The 2009 values established by Cabinet Office (2012) are adjusted by using GDP-deflator.
- Note 1: "Deaths" are cases in which a traffic accident results in death within 24 hours of the accident. "Serious injuries" are injuries requiring medical treatment for 1 month (30 days) or more. "Slight injuries" are injuries requiring medical treatment for less than 30 days.
- Note 2: Cabinet Office (2012) categorizes injuries into two sectors of "Injuries with residual disability" and "Injuries without residual disability," while Japan Traffic Accidents General Database, J-TAD (macro), classifies injuries into two classes of "Serious injuries" and "Slight injuries." Here, we have assumed that J-TAD (macro) categories of "Serious Injuries" and "Slight Injuries" correspond to "Injuries with residual disability" and to "Injuries without residual disability" in Cabinet Office (2012) respectively.

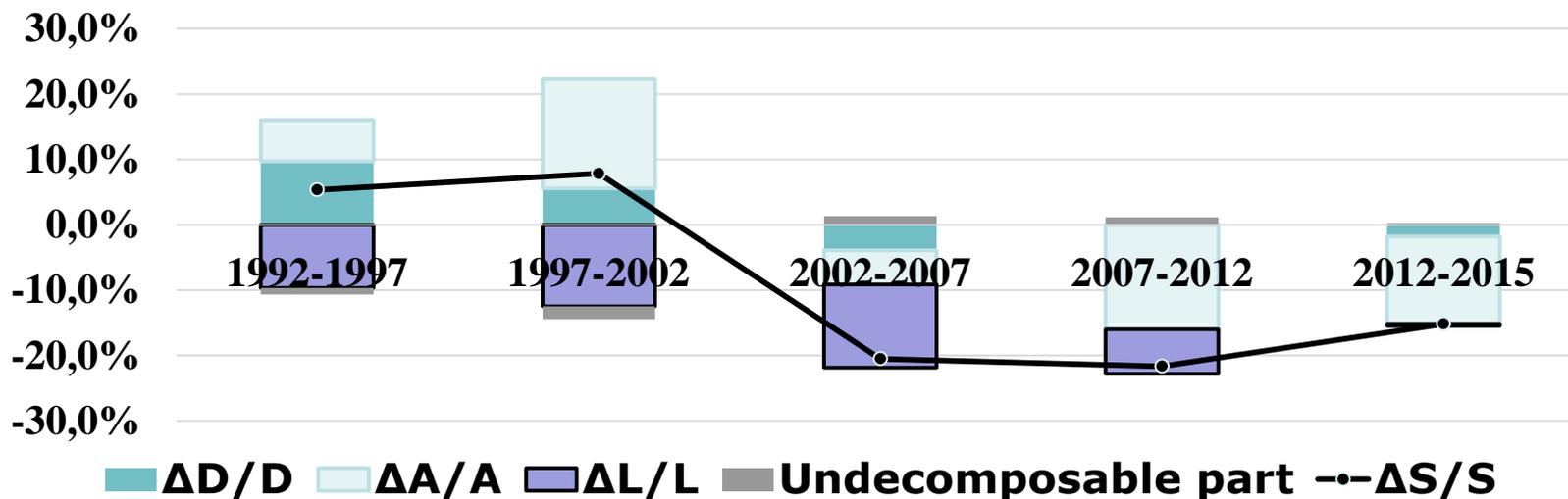


Conclusion 1

- **Passive safety technologies have contributed significantly to the reduction of economic losses due to road traffic accidents in Japan.**
- **It seems that the magnitude of additional contribution from passive safety technologies have lessened considerably in recent years.**
- **Diffusion of active safety technologies will be needed in order to reduce the economic losses dramatically.**



Decomposition of the Rate of Change of Economic Losses due to Road Traffic Accidents in Japan (Accidents between Four-Wheeled Vehicles)



- S** : Economic losses due to road traffic accidents
- D** : Total distance traveled (billion vehicle-kilometers)
- A** : The number of accidents per billion vehicle-kilometers
- L** : Economic losses per accident

$$S = D \cdot A \cdot L \rightarrow \Delta S/S \div \Delta D/D + \Delta A/A + \Delta L/L$$

Note: Losses due to accidents involving special purpose vehicles are not included

Source: Miyoshi (2016) using J-TAD (macro)



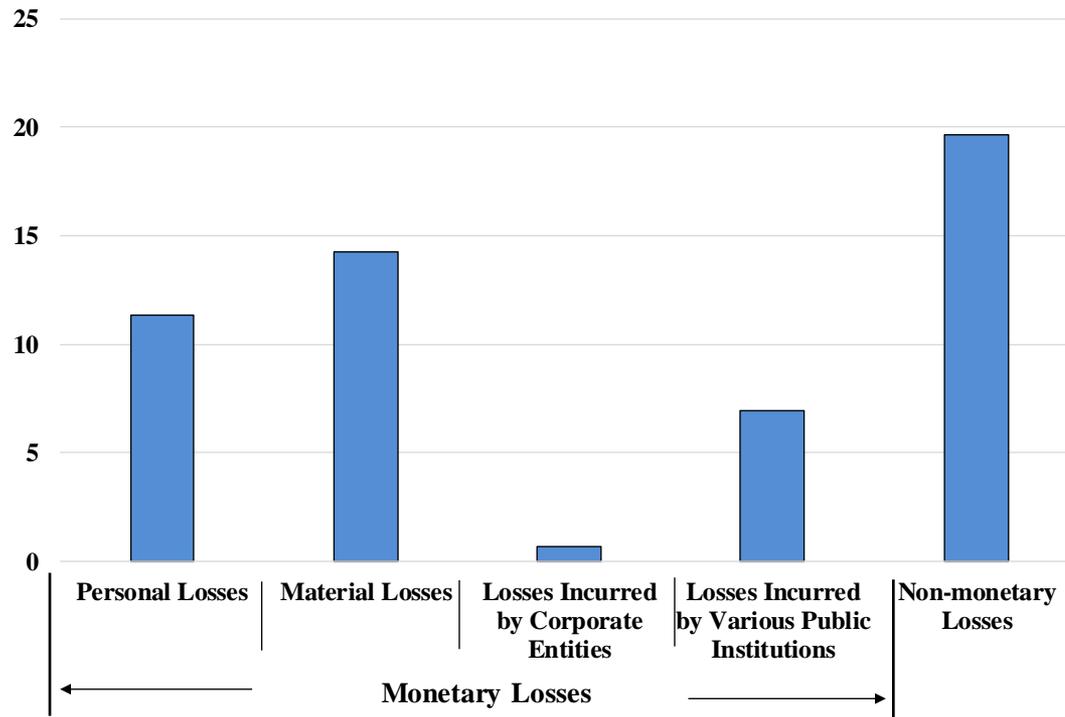
Conclusion 2

- **Economic benefits of the automated driving systems will be enjoyed not only by the users but also by many economic entities including non-users, firms, public institutions.**
- **It can also be said that Automated Driving Systems are *safety-sharing system*.**
- **Magnitude of benefits and their attribution differ depending on utilized technologies.**
- **Redistribution of costs burden among the related economic entities will be necessary for facilitating diffusion of the automated driving systems in the society, considering economic features of each technology**



Economic Losses due to Road Traffic Accidents in Japan (2009) (All Types of Road traffic Accidents)

Billion EUR (120 Billion JPY)

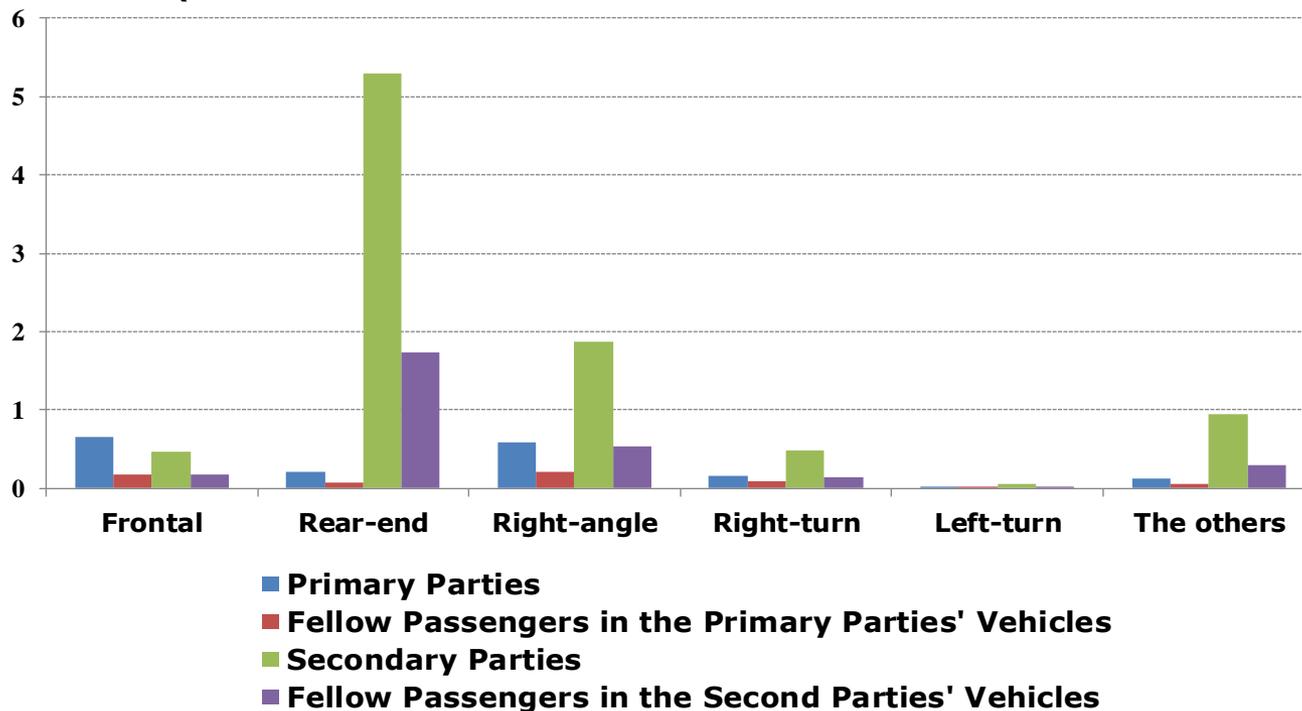


Source: Prepared by author in reference to Cabinet Office (2012)



Losses by Accident Type in 2015 (Accidents between Four-Wheeled Vehicles)

Billion EUR (120 Billion JPY)



Source : Calculated by author using 2015 data provided by ITARDA



Economic Features of the Technologies : Rear-End Collision Prevention

System types	New user's Benefit	Externalities	Contents
		Enjoyed by	
Autonomous	Avoidance of collisions with <i>all vehicles running ahead</i>	<i>All Vehicles</i>	Increase of the probability of avoiding collisions with vehicles <i>running behind</i>
Vehicle-to-Vehicle (V2V)	Avoidance of collisions with <i>equipped vehicles running ahead and behind</i>	<i>Already equipped vehicles</i> (Network externality)	Increase of the probability of avoidance of collisions with vehicles <i>running ahead and behind</i>



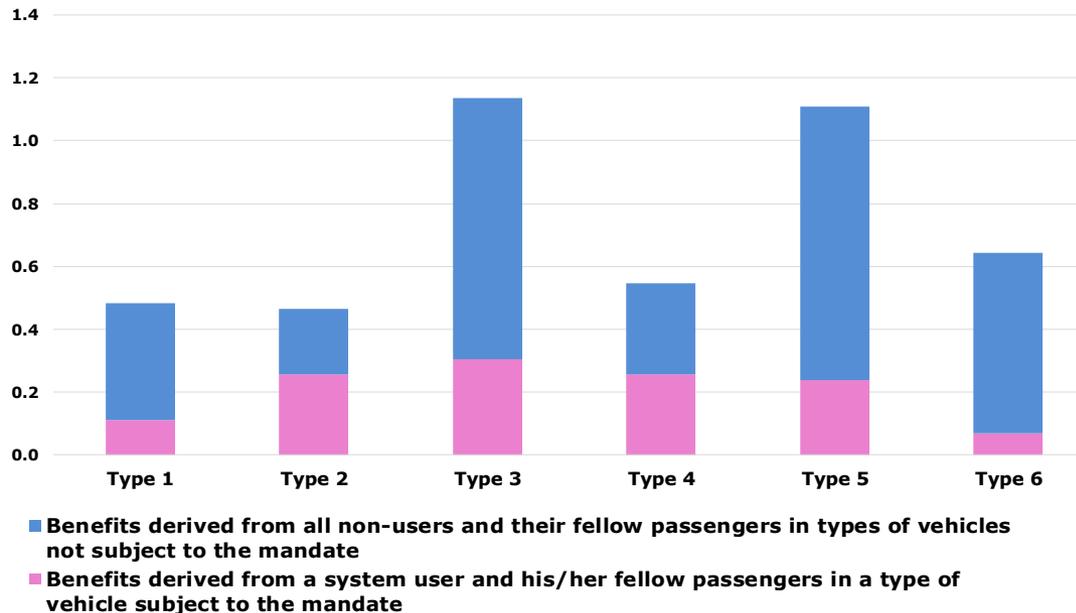
Conclusion 3

- **Japanese safety regulations for road transport vehicles call for mandatory installation of (autonomous) collision-mitigating brakes and lane-departure warning devices on new trucks at over 3.5 ton GVW and new buses with capacity for 10 or more passengers (stepwise introduction from heavy vehicles)**
- **Our analysis finds it appropriate to assign high priority for mandatory installation of collision-mitigating brakes to trucks at over 3.5 ton GVW and *Taxis*.**



Benefits from Mandatory Installation of Autonomous Devices for Rear-end Collision Prevention

Thousand EUR (120,000 JPY)



Type 1: standard/small buses, **Type 2:** standard/small passenger vehicle for private use, **Type 3:** standard/small passenger vehicle for commercial use (taxis), **Type 4:** mini vehicle, **Type 5:** standard/small truck at over 3.5 ton GVW, **Type 6:** standard/small truck at 3.5 ton or less GVW

Note: Estimated based on the assumption that the installation of devices is 100% effective in averting accidents.

Source: Miyoshi (2016) using 2015 J-TAD (macro)

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Thank you for your kind attention!

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References

Cabinet Office, Government of Japan (2012), *Report of the Survey on Economic Analysis on the Damage and Loss of Road Traffic Accidents*, March 2012 (in Japanese)

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