

**“Technical Research and Development for Road Policy Quality Improvement”
Study Summary**

No.	Title	Principal Researcher
No.28-4	Research on introduction possibility of one-way type car sharing system and new utilization method of road space	Kumamoto Univ. Prof. Shoshi MIZOKAMI

The purpose of this research is to clarify the possibility of introducing one-way car sharing service to Japan and its impacts. We analyzed the current situation and usage awareness of car sharing services in Europe and the United States, and carried out demand forecasting and impact evaluation of car sharing service using the originally developed mesoscopic traffic flow simulation, K-MATSim (Kumamoto Multi-Agent Traffic Simulation) model, as well as operational macroscopic simulation model.

1. Backgrounds and Objects

In order to introduce one-way type car-sharing into Japan, it is necessary to consider not only the demand forecasting but also efficient service operation methods such as optimal allocation of stations and charge level. We analyzed the current situation and preference for car sharing services in Europe and the United States, and carried out demand forecasting and impact evaluation of car sharing service using the originally developed both of mesoscopic traffic flow simulation and operational macroscopic simulation model.

2. Activities in Research Period

The main activities in this research period are as follows;

- 1) Analyze the current situation and usage awareness of CS services in Europe and the United States.
- 2) Conduct a stated preference survey for CS service in daily life, examine the possibility of introducing car sharing service and estimate the modal conversion model to CS service and develop a macroscopic simulation model for CS operation that incorporates the above modal conversion model and mesoscopic traffic flow simulation model.
- 3) We apply the simulation model for some urban areas where has different scale and characteristics were conducted, and examine the feasibility of station-type car sharing service. By clarifying the effects and problems of placing the station off the road and on the road, we will consider how to use the road space.
- 4) Investigate a prototype method of demand forecasting and impact evaluation for autonomous driving vehicle sharing service.

3. Study Results

The research results of the above 1) to 4) are outlined below in order.

- 1) We visited Paris and Berlin in 2016, and Paris, Lyon, Bordeaux and London in 2017, and discussed with local governments, local transportation planning consultants, and university professors. In particular, we have investigated in depth the usage and operation of station-based car-sharing Autolib' in Paris. A survey on Autolib', which was conducted in 2011 and 2013, was conducted in 2016 as well. From these results, the situation of use and operation of car-sharing business in Europe and US was clarified. Furthermore, it became clear that it is necessary to study feasibility from the viewpoint of profitability depending on the business scale and service provision area.
- 2) In 2014, we conducted the “Stated Preference Survey on MEV Car-Sharing”. About 30% of respondents indicated their intention to convert from current modes to MEV car-sharing. The conversion model to MEV car-sharing estimated using this stated preference data has become a creative model which includes "probability of not being able to receive a reservation" as one of explanation variables. We developed a multi-agent type car-sharing operation simulation model with a structure in which the value of "probability of not being able to receive a reservation" is updated depending on the results of other people's behaviors in the daily iteration process. Furthermore, we developed a mesoscopic traffic simulation model that represents dynamic traffic flow on the road network. This simulator not only has the standard performance that the traffic flow simulation model should have, but also has the function that enables various transportation policy analyses.

- 3) The simulation model was executed for three cities with different size and traffic characteristics. Results show that profitability is improved if the business is conducted only in the area limited to the central part in the Kumamoto urban area. Lowering the fare for trips whose destination is the periphery can promote the use of car-sharing services, as well as can alleviate the demand and uneven distribution of vehicles spatially and temporally. Also, by clarifying the effects and problems of placing the station off the road and on the road, we will consider how to use the road space. The influence on the road traffic flow due to the on-road car-sharing station was predicted using K-MATSim. Although traffic volume on the links upstream and downstream of stations decreases, traffic volume on the links around the station increases because of the detouring vehicles. In particular, the tendency was remarkable around the station installed near the intersection with high traffic volume.
- 4) We developed a prototype simulation model that interpolates a demand forecasting and service supply for an Autonomous Vehicle Sharing service. Results of executing simulation for Kumamoto metropolitan area show that about 1.7% of the total number of trips will be converted to this service and total parking time in the downtown area will be dramatically reduced by as much as 15%.

4. Papers for Presentation

- 1) Shoshi MIZOKAMI, Toshikatsu MORI (2019), The end of Autolib' and future prospects for car-sharing services – Based on the business of Autolib' in Paris -, Traffic Engineering, No.53, Vol.5, pp.43-51.
- 2) Shoshi MIZOKAMI, Toshikatsu MORI (2018), Possibility of introducing car-sharing services to Japan – Based in the operation of Autolib' in Paris -, Traffic Engineering, No.53, Vol.4, pp.54-60.
- 3) Shoshi MIOZKAMI: Mobility and society combining autonomous driving technology and sharing services, International Academic Seminar on “New Mobility and Society Combining Autonomous Driving Technology and Sharing Service”, Campus Innovation Center of Tokyo Institute of Technology, 2018.11.30, Tokyo.
- 4) Kenta NAKAMURA, Shoshi MIZOKAMMI, Junya HASHIMOTO (2017), A feasibility study on introducing one-way car-sharing system and its allocation of stations, JSCE-D3, Vol.73, No.3, pp.135-147.
- 5) Yugo FURUSAWA, Shoshi MIZOKAMI, Kenta NAKAMURA (2017), A simulation study on car-sharing service operation considering its spread process, JSCE- D3, Vol.73, No.5, pp.I_1003-I_1012.
- 6) Shoshi MIZOKAMI, Demand Forecasting and management Method of Electric Vehicle Sharing System – Simulation Model of One-way Micro Electric Vehicle (MEV) Sharing System, Car Sharing Association Annual Conference, May 18th - May 9th, 2017, Montreal, Canada.

5. Study Development and Future Issues

In addition to the Autonomous Vehicle Sharing service that provides sharing services by autonomous vehicles, the Autonomous Vehicle Ride Sharing service, which allows many passengers to ride in AVS, can be the ultimate mobility service. However, it is necessary to consider in advance social and urban issues such as whether such mobility services can be accepted by citizens, what will be the role of traditional public transportation services, whether parking spaces occupied by private cars are necessary in cities as before.

6. Contribution to Road Policy Quality Improvement

As a member of "committee on car-sharing social experiment utilizing road structure and space" constituted by Tokyo National road Office, Ministry of Land, Infrastructure, Transport and Tourism, in 2016, the findings from this study were introduced at every committee meeting. We have proposed the implementation plan of car-sharing experiment using road space in the center of Tokyo. The results are reflected in the notes on setting up and operation of the car-sharing station. The committee continues its activities in 2019.

7. References, Websites, etc.

Websites etc. have not been established especially yet. However, We plan to disclose the performance, functions and application of K-MATSim, and have them be widely applied to traffic flow and transportation policy analysis.