

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

No.	Title	Principal Researcher
No.29-3	A study on development measuring the value of mobility in quality transport era	Prof. Akimasa Fujiwara, Hiroshima University

The social acceptance of Connected Public Transport System for the purpose of reconstructing the method of measuring the value of mobility in order to realize the quality transportation in which travelers with different values of time and time constraints

1. Backgrounds and Purpose

In Japan, which has entered a super-aged society, "quality transport" services are required. The quality transport refers to finely-tuned mobility services supported by innovative technologies, such as autonomous vehicles that prevent human error. These services are considered to be especially useful for elderly people with impaired physical and mental functions, but it is necessary to review the method of measuring the value of mobility (VOM) in several ways. The purpose of this research is to reconstruct the method of measuring the VOM in a super-aged society in which travelers with different time values and time constraints coexist.

2. Activities in Research Period

In the first year, we will review the existing theories on the value of time (VOT) measurement and develop a theoretical framework, study on elderly's willingness to return driver's license and the value of driving license possession, design a virtual reality choice experiment of Connected Public Transport, and evaluate the social acceptance of self-driving technology based on stated preference survey.

In the second year, a study on the measurement methods of VOT for an integrated transport between passenger and goods will be done as well as the value of driver's license possession by applying a new method measuring driving functions of elderly drivers, and the social acceptance of Connected Public Transport to verify the effectiveness of VOT measurement methods by a virtual reality choice experiment.

In the final year, social acceptance of the Connected Public Transportation System will be clarified by a behavioral experiment, and the usefulness of comprehensive evaluation methods for road projects in the high-quality transportation era will be shown.

3. Results (excerpted)

(1) Value of travel time saving

1) Measurement of value of travel time saving for integrated transport between passenger and goods (ITPG) services in depopulated areas

Since various users with different VOTs get on ITPG services that operates more efficiently, travel mode choice models were estimated to measure VOTs. Then, we developed a method of optimizing the ITPG operation route as a common transport service.

2) Effects of multitasking in autonomous vehicle on residential choice behavior

It was verified by SP research that a fully self-driving car enables multitask while traveling and has less resistance to longer travel times. After evaluating the feasibility of multitasking for each activity type, a residential choice behavior model (Panel Binary Mixed Logit) found that the diffusion of AV could cause changes in the urban form.

(2) Value of accessibility

1) Development of a diagnostic system for returning driving licenses for the elderly

A diagnostic system that measures whether or not elderly drivers with advanced diseases such as dementia can continue to have a driver's license was developed. A public road driving experiment proved its applicability.

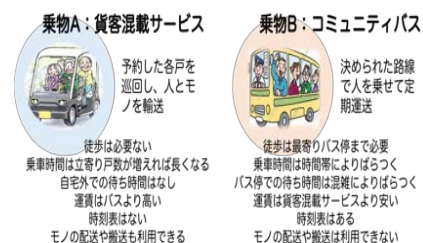


Fig. 1 SP survey on integrated transport between passenger and goods

Panel Binary Mixed Logit Model

$$P_{int} = \frac{\exp(V_{int} + b_{in})}{\sum_j \exp(V_{int} + b_{jn})} f(b_n) db_n$$

P_{int} : choice probability of individual n , residence I at time t ,
 V_{int} : systematic utility of individual n , residence I at time t ,
 b_n : random utility of individual n

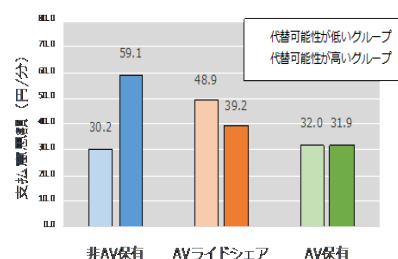


Fig.2 Value of AV travel time saving

2) A collective household model of driving cessation for elderly
 A collective household model was developed to describe a decision-making structure after communication between the elderly and his/her families.

3) Numerical simulation on the feasibility of ride-sharing system
 In a mountainous area, we set up a meeting point for both drivers and users and built a simulation model to measure the feasibility of ride-sharing that runs under the constraint of their activity schedule.

(3) Value of connectivity

1) Risk perception and social acceptance of self-driving vehicle

A user's risk perception map for self-driving technology using vehicle-to-infrastructure/vehicle-to-vehicle communication system was created, and it was found that the perception of unknown risks for self-driving technology was higher than ones for other advanced technologies.

2) Measuring the value of connected system between autonomous bus and LRT by social experiment

We conducted the world's first pilot test of a connected system of autonomous bus and LRT, in which the bus entered the LRT track from a general road, followed previous vehicles safely and then returned to the road again. The system accurately kept the lane on the track, recognized the preceding stopped vehicle at the stop correctly. It was confirmed from a survey for monitors experienced the advanced technology that there was a high potential of social acceptance of the system in market.

4. Papers for Presentation

1. Namgung H., Fujiwara A. et al. (2019) Estimating Heterogeneous Value of time for an Integrated Transport between Passenger and Goods: A Case study in a Japanese Rural area, Journal of the Eastern Asia Society for Transportation Studies 13, 1321-1332.
2. Kakujo R., Chikaraishi, M., Fujiwara A. et al. (2020) Heterogenous effects of multitasking in autonomous vehicles on residential location choice behavior, TRB 2020 (CD-ROM).
3. Fukui N., Chikaraishi, M., Fujiwara A. et al. (2020) A collective household model of driving cessation of older adults, in "Mapping the Travel Behavior Genome" (K.G. Goulias and A.W. Davis, eds), Paperback ISBN: 9780128173404, eBook ISBN: 9780128173411, Elsevier
4. Chikarashi M. et al. (2020), Risk perception and social acceptability of autonomous vehicles: A case study in Hiroshima, Japan, Transport Policy, <https://doi.org/10.1016/j.tranpol.2020.05.014>

5. Future Prospects and Works

Through the pilot test of connected system of autonomous bus and LRT, the possibility of introducing the system could be verified from a technological aspect. In order to conclude its social acceptability, similar empirical studies will be required in various cities with different conditions in the future.

6. Contribution to Road Policy Quality Improvement

In order to increase the value of mobility in the quality transport era, all policies are effective to reduce travel time, improve accessibility, increase connectivity, and enrich resilience, and besides a comprehensive road policy that integrates these measures has contributed to the improvement of quality. At present, based on the results of this research, it has been developed into verification research on road-to-vehicle communication technology between autonomous vehicles and traffic signals, general vehicles, vehicle-to-vehicle communication technology for buses and LRTs, and automated driving technology in mountainous areas. Therefore, continuous contribution and development can be expected for the realization of high-quality transportation services.

7. References, Websites, etc.

<https://danro.asahi.com/article/12990184>



Fig.3 Diagnostic system for returning driving licenses

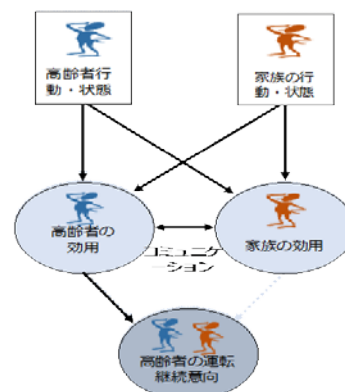


Fig.4 Communication between the elderly and his/her families in collective household



Fig.5 World's first pilot test of connected system of autonomous bus and LRT