"Technical Research and Development for Road Policy Quality Improvement" Study Summary

No.	Title	Principal Researcher
No. 29-1	Research on new road traffic measures to support the "Production Space" using the autonomous driving and roadside stations	Muroran Institute of Technology Assoc. Prof. Mikiharu Arimura

The aim of this research is to verify the effectiveness and social acceptability by implementing the social experiment with new road traffic measures, including the practical use of autonomous driving or roadside stations. We develop the evaluation model, thereby we evaluate and propose the road traffic environment which is available to continue to live in the "Production Space" in Hokkaido. It contributes to other regions facing the same problem by verifying various problems in Hokkaido where the population decline proceeds for 10 years earlier than others.

1. Backgrounds and Objects

The countermeasures against the progressive demographic shrinking, low fertility rate and hyper-aging society in the Grand Design of National Spatial Development towards 2050 showed the necessity of geographical "compactification", and "networking" to secure the population in the regions for maintaining the advanced urban function and for reconstructing the regional public transport network.

On the other hand, the declining population of Hokkaido is progressing quickly for nearly 10 years than the national average. In the rural regions with the regional structure of scattered types which is the "Production Space" of the tourist spot and the food base of our country, it is susceptible to a declining population, and likely that it faces difficulties to maintain the logistics and the public transport. Likewise, concerns are growing after JR Hokkaido announced "13 sections of 10 train lines hard to maintain without outside help (18 Nov 2016)". Thus, both sides of the lives and industries (logistics and tourism) in the "Production Space", the introduction of the effective and sustainable measure concerning road traffic is strongly required.

Recently, cutting-edge technologies which are autonomous driving, public transit systems such as BRT and on-demand buses, and measures of logistics such as transportation that contains both passenger and freight have progressed.

Meanwhile, the uses of roadside facilities such as roadside stations(Michi-no-Eki) are concentrated as its transportation hub. Founded on these results, this study explores new road traffic measures aiming for the road traffic environment that can continue to live in the "Production Space".

2. Activities in Research Period

Theme 1: Knowledge acquisition for "new road traffic measures" study

In the Southern Tokachi area (Hokkaido), we implemented a pilot program combined with "new road traffic measures" including autonomous driving and roadside stations, and we verified its effect and social acceptability, feasibility, and sustainability.

We implemented a driving experiment for evaluating the relation between road environment and manual intervention during autonomous driving under the road environment in winter. Using a driving simulator, we examined the road environment and operating conditions for autonomous vehicles to drive safely and the provision of information.

Theme 2: Research and development of "new road traffic measures"

By combining new road traffic measures using roadside stations, we considered sustainable logistics and its environment by ensuring convenience for tourists, consumers, and logistics in the "Production Space".

We developed an evaluation model through an experiment, including autonomous driving, and evaluated it. The result suggested new road traffic measures for continuing to live in the "Production Space" of Hokkaido. Using the knowledge gained from this study, we considered the contribution and application for other regions having the same problem.

3. Study Results

(1) Knowledge acquisition for "new road traffic measures" study

1) Survey and analysis of wide-area public transportation services with autonomous driving and roadside stations

・ We grasped the present situation about issues, costs, responses, effect corresponding to the introduction of the measure, through the hearing data from transportation operators, questionnaire surveys on community residents,

and some data from the pilot program.
- We gained insights on future mobility in regions suffering from population decline. This consisted of social acceptance of self-driving technology, reduction of movement burden including wide-area movement for settlement, and stricter public transportation operation due to the aging of drivers etc.

2) Ensuring the safety of introducing autonomous vehicles on the winter road
- We gained the knowledge about methods of information provision and measures of maintenance/management of road through the followings. It is required to override according to the road condition on the winter road. It is tending to shift the running position by forming a rut. The road conditions significantly affect the driver's sense of crisis.

(2) Research and development of "new road traffic measures"

1) Developing an evaluation model
- We developed the model to decide the amount of a service supply such as the number of vehicles required, routes, a traffic demand for public transport service, and the model utilizing road stations. Considering a benefit measurement method using items by output from models and considering integration methods for operating costs, we evaluated the investment efficiency of the improvement plan.

2) New road traffic measures in the Southern Tokachi area
- Using the evaluation model, we evaluated some scenarios of "new road traffic measures" in the Southern Tokachi area. We reached to propose the vision for the future in the Southern Tokachi area.

3) Application possibility in other regions
- Extracting two regions suffering declining population, we considered the application possibility of High-Grade Trunk Roads and wide-area autonomous driving public transportation service using roadside stations.

4．Papers for Presentation
1. S.Sakamoto, **M.Arimura :** Application of Branch and Price Method to Dial a Ride Problem based on Active Diary Survey, 24-January,2020.
2. A.Sasaki, K. Takahashi, N.Sugiki, **M.Arimura :** Construction of QOL Index in Automatic Operation introduction and ITS Application, 59th Spring Conference on Infrastructure and Management,June 8-9, 2019.
3. M.Shinobu, N.Sugiki, K.Matsuo : Evaluation of Autonomous Driving Public Transportation System by Activity Based Model Considering the Interdependence of Travel Behavior, 60th Autumn Conference on Infrastructure and Management, November 30-December 2, 2019.
4. N.Shiroishi, S.Takahashi, T.Hagiwara, N.Okada, T.Naito, I.Munehiro : Effects of Winter Road Surface on Driver's Risk Avoidance Behavior when the Vehicle Are Entering a Curve with Adaptive Cruise Control.
5. Y.Shimada, K.Kishi : Public Transportation Network for Settlement in Production Space in Hokkaido,60th Autumn Conference on Infrastructure and Management, November 30-December 2, 2019.

5．Study Development and Future Issues
- Though many problems exist in the future of public transportation services using autonomous driving, local residents have become conscious that the local transportation reaches an impasse and they have considered the future of public transportation service by themselves. It is the maximum effect in the demonstration experiment that such opportunities have matured.
- Declining population induces withdrawal of facilities; as a result, the range of mobility for local residents is expanded. That means it diminishes the quality of life, then it makes an even more declining population. Nowadays, since regions in declining population cannot get out of a vicious circle, the mobility revolution using ICT such as MaaS and autonomous driving would be their last opportunity in the "Production Space".

6．Contribution to Road Policy Quality Improvement
- Through this research and development, we gained the knowledge that new mobility services provided on the road with autonomous driving systems have the following possibilities.
  - ✓ Function effectively in the future of the "Production Space".
  - ✓ Report as new benefits to evaluate the efficiency of road investment.
  - ✓ Road performance is immediately linked to the degree of its social utility.
  - ✓ Implement advanced management of mobility services by managing and transmitting road performance as dynamic information.
- Therefore, this research reported the road management with mobility services providing on the road might be the main-axis of future road traffic policies, and we expect further research and development with such a view in the future.

7．References, Websites, etc. [None]