

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

No.	Title	Principal Researcher
No.31 - 2	Transportation Hub Planning and Management for Modal Connection in Multiscale Network	Univ. of Tokyo Assoc Prof. Takahiko Kusakabe

This study develops a framework and methodologies for planning, designing, evaluating, and monitoring transportation hubs for next-generation mobility. The proposed framework and methodologies incorporate the novel big data and sensing data such as ETC 2.0.

### 1. Backgrounds and Objects

This study focuses on transportation hubs that are the significant facilities for multi-scale and multi-modal connections including mobilities between last-one-mile and interurban ones. The aim of this study is to develop the framework for planning, designing, and evaluating measures for transportation network considering the society equipped with the next-generation mobility system by implementing evaluation of multiscale transportation network considering last-one-mile, door-to-door, and hub-to-hub connections.

By incorporating the novel big data and sensing data such as ETC 2.0, this study conducts:

i. Developing monitoring methodologies for the demand of hubs including “Michi-no-Eki” to investigate management measures.

Considering features observed by i, this study proposes the following methodologies for mobility including last-one-mile, door-to-door, and hub-to-hub connections.

ii. Proposing the improvement of inter- and intra- region mobility connecting hubs including “Michi-no-Eki” in low population density area.

iii. Developing a methodology for planning mobility hubs in the inner-city areas considering next-generation mobility.

### 2. Activities in Research Period

Based on the development of i-iii, this study investigates the framework of planning, designing, evaluating, and monitoring of hub using bigdata. The implementation of the proposed framework and methodologies for road administration and management are discussed.

For objective i, firstly, we conducted “the requirements for indices of evaluation of multimodal connection hub”. Then, we develop a “hub detection method” with probe vehicle data, and a “demand monitoring method” with big data. To illustrate the results of these methods for practitioners, we propose a visualization system with a web-based dashboard. For objective ii, we develop “demand estimation method based on travel behavior survey with BLE (Bluetooth Low Energy) tags”. The case study is conducted with the survey in Hitachi-ota city in Ibaraki prefecture. We formulate a mathematical program for determining SAV(Shared Autonomous Vehicle), traffic flow, fleet size, and capacity of links and pools. For objective iii, we performed a “travel mode behavior survey considering next-generation mobility” incorporating with experimental service of an autonomous vehicle bus. The scenarios are investigated and evaluated with the mathematical program, and multi-agent travel simulation.

### 3. Study Results

This study has proposed the framework using the developed methodologies in the shown processes in Fig.1. The proposed methodologies enable us to conduct the data-driven approach in each process, proposing relevant alternatives with mathematical programming, and evaluation or benchmark with simulation. The proposed visualization system (Fig.2) supports us including

practitioner to interpret bigdata and results of proposed analyses.

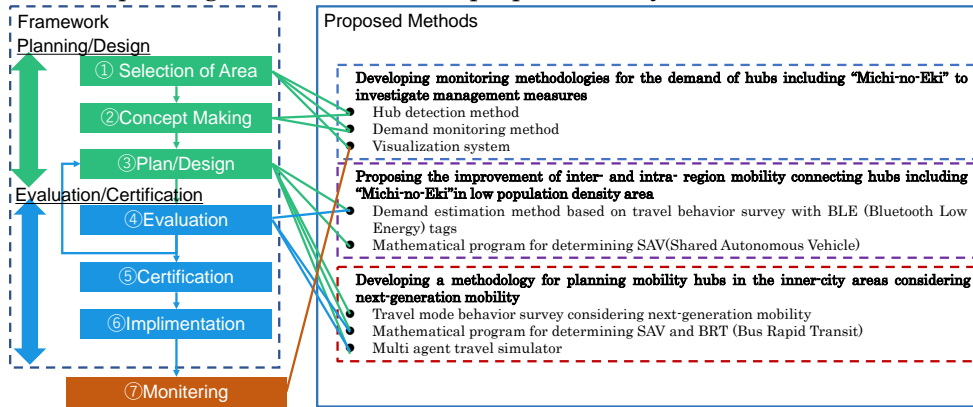


Fig.1 Contribution of proposed framework of road administration and management.

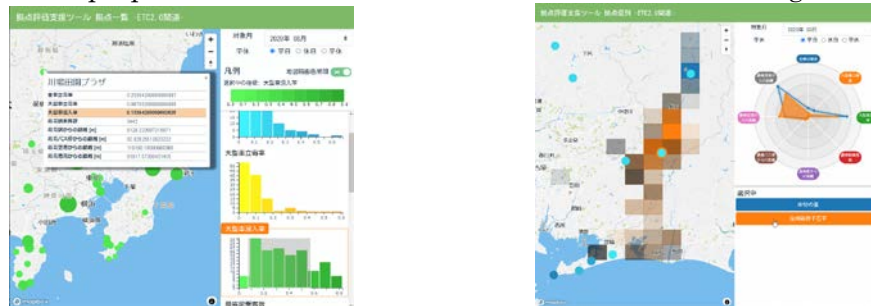


Fig.2 Demonstration of visualization system

#### 4. Papers for Presentation

Minato, Y., Kawada, A., Mitani, T., Suga, Y., Masuda, S., Yaginuma, H., Kusakabe, T. : Travel Behavior Survey Using Bluetooth Low Energy for Rural Area, The 60th Conference on Infrastructure Planning and Management (JSCE), 2019.(Written in Japanese)

Seo, T., Asakura, Y. : Multi-Objective Linear Optimization Problem for Strategic Planning of Shared Autonomous Vehicle Operation and Infrastructure Design, IEEE Transactions on Intelligent Transportation Systems, vol.23, 4, 2022. ( <http://dx.doi.org/10.1109/TITS.2021.3071512>)

#### 5. Study Development and Future Issues

The contribution of this study can be utilized as the extension and advancement of the “Practical Guideline on Development Plan for Road Network coping with Autonomous Driving” and “Evaluation/Certification Guideline on Development Plan for Road Network coping with Autonomous Driving” which are proposed by the CART project “New evaluation methods for road stock aimed at spreading the autonomous driving system in diversified regions that actively interact with other regions”(No.29-2), which is finished in 2020. The proposed framework is expected to use for planning, designing, evaluating, and monitoring road networks with next-generation mobility, incorporating above mentioned guidelines. For the future extensions and implementation, additional case studies are required for implementing parameters from observation and validating each methodology.

#### 6. Contribution to Road Policy Quality Improvement

The proposed monitoring and visualization system could be well utilizable for analysis of dataset from xROAD (Data platform of road infrastructure) since it can utilize ETC2.0 dataset.

#### 7. References, Websites, etc.

Experiment of Bus Service with Autonomous Vehicle in Saitama-Shintoshin Station : <https://www.youtube.com/watch?v=ftS4FmLIw20>