

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

No.	Title	Principal Researcher
No.2020-3	Research of functional evaluation of resilient smart city hubs centered on bus terminals	Hiroshima Univ. Prof. Akimasa Fujiwara

The purpose of this research is to develop a method for measuring and evaluating the functions of a centralized public transportation terminal in terms of both normal and disaster operations, and to clarify the required functions of transit terminal based on this method in order to enhance regional vitality and form a disaster-resistant smart city base based on transportation, not just a transportation node function.

### 1. Backgrounds and Objects

In response to the torrential rain disaster in western Japan in July 2018, there is a growing social demand for transportation modes such as BRT in times of disaster and for the enhancement of functions of transportation nodes. There is no established evaluation methodology for the functions of transportation nodes other than those of transportation hubs. The purpose of this study is to develop a method for measuring and evaluating the functions of a centralized transportation terminal, from the perspective of both normal and disaster operations, in order to enhance the vitality of the region based on transportation and to form a disaster-resistant smart city hub, in addition to the functions of a transportation node. The objective of this project is to develop a method for measuring and evaluating the functions of transportation terminals, and to clarify the required functions of transportation terminals based on this method.

### 2. Activities in Research Period

In the first year, this study reviewed the functions of existing transit terminals and conducted a questionnaire survey to assess the functions of transit terminals in the event of a major disaster. In addition, a demonstration experiment of next-generation urban mobility connectivity was conducted. In the second year, this study analyzed the function and management situation of the terminals. In addition, a demonstration project on disaster response transport services was carried out under the assumption of a disaster. In the final year of the study, a field survey of overseas transit terminals was conducted. An evaluation method for the functions performed by bus terminals was proposed and verified in a real city. Finally, the study concluded on the required functions for future bus terminals.

### 3. Study Results

#### (1) Research on the functions of transit terminals

##### 1) Review of trends in centralized transit terminals

Trends in the development concept, operation and management methods of centralized public transit terminals at home and abroad were investigated, and information was obtained on the concept of resilience hubs, which integrate the functions of transit terminals and local community hubs, as an example, and examples (Transbay Transit Center, USA) of terminals developed according to similar concepts.

##### 2) Understanding the functional needs of transit terminals in the event of a major disaster

A review of past large-scale disasters was conducted, not only wind and flood disasters, but also earthquakes and snow disasters, to clarify the roles played by transit terminals and people's behavior patterns, particularly in the post-disaster phase.

##### 3) Planning strategies for the introduction of resilient 'next generation transport hubs'.

Resilient transport hubs (bus stations) are places where different modes of transport are concentrated and where many users come and go to make connections, etc. They need to function as transport hubs not only in normal times, but also in times of disaster. In addition to the functions of conventional transport hubs, the functions required of resilient bus stations include a "central function" to provide support for disaster response

headquarters in the event of a disaster, an expanded "disaster prevention function" to ensure transport functions in the event of a disaster and temporary accommodation for people who have difficulty returning home, and a "bi-function" to ensure that the function is also fulfilled in normal times. The functions and operations of the facility based on the bi-function concept are also presented to ensure that the facility can also function in normal times.

#### (2) Development of evaluation methods for smart city hubs

##### 1) Study of measurement indicators and methods

A method has been developed in which "experts", such as those with experience in dealing with past disasters, are asked to derive the functions that a traffic terminal should have through questionnaires and discussions at the planning stage of the development of traffic hubs.

##### 2) Development of measurement techniques for observational data

In the case study described later, we developed a technology for monitoring the movement of people and vehicles and the situation in the city, and a system that can also be shared remotely, and verified it.

##### 3) Examination of management organization

Based on the functions and operations of the facility based on the bi-function concept described above, we proposed the establishment and operation of an industry-government-academia organisation that would promptly implement disaster management, including traffic operations, in cooperation with the public and private sectors, and also manage normal operations.

#### (3) Case study to evaluate the functions of transport terminals

Case studies were conducted to evaluate the individual functions of transport terminals and to verify the usefulness of the above technological developments.

#### 4. Papers for Presentation

1. Binh Nguyen Mai, Thi Anh Hong Nguyen, Akimasa Fujiwara and Canh Do : Impacts of A dverse Weather on Mode Choice Behavior: A case study in Hanoi City, Vietnam , The 6t h International Conference on Green Technology and Sustainable Development , Nha Trang University, Khanh Hoa Province, Vietnam , 2022/7.
2. Hyewon Namgung and Akimasa Fujiwara : Small and Medium-sized Taxi Firm Operators' Stated Choices of Future Business Models: A Case Study in Japan based on Hybrid Choic e Model with Panel Effects , International Conference Series on Competition and Ownershi p in Land Passenger Transport , Grace Hotel in Sydney, 2022/9.
3. Natsuki Nagasaka, Akimasa Fujiwara, Makoto Chikaraishi, Kiriko Sakata : An Analysis of Evacuation Decision-Making with Dynamic Discrete Choice Model Considering Situation Re definition in Heavy Rainfall Disasters , The 102nd TRB Annual Meeting , University of t he Ryukyus , 2023/1.

#### 5. Study Development and Future Issues

Many issues relating to the management of transit terminals once they are in operation are likely to become clearer. In addition, different types of transit terminal are being planned in many areas, so wider generalization is needed. We will continue to monitor these issues and contribute to road policy through further study and review after the end of this research period.

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

The research findings of this study were immediately applied to practical projects. They have been reflected in the discussion of a public-private partnership management organization based on a transit terminal that also takes into account emergency response, and in the consideration of the establishment of facilities.

As described above, the research results have already been returned to society and implemented, but we will continue to work on the development and practical application of our research so that the results of this research can contribute to more regions and projects in the future.

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

<https://www.ykandalab.net/research-themes/seminar/> (seminar website)