

Development of Standard Activity-based Simulator (ABS) Utilizing the Nationwide Urban Transportation Characteristics Survey Data

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1. Activity and mobility of a diversifying population

Urban transportation measures are now required that involve not only quantitative response but also that cover the qualitative aspects for improving the well-being of each individual in urban life, against the background of low fertility and population aging, new ways of life such as telework and diversification of activities in public space, propagation of readily available mobility such as GSM (Green Slow Mobility), and the advancement of new technologies such as big data and remote technologies.



Fig.-1 Post-Covid urban activities have become diversified

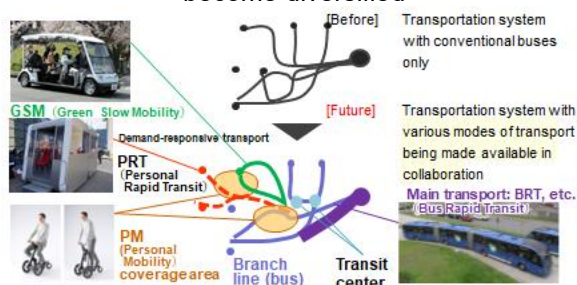


Fig.-2 New mobility that is readily available in the living-sphere

2. Development of ABS utilizing the nationwide PT survey data

For the purpose of EBPM (Evidence Based Policy Making) in local administration, in the planning for urban transportation planning, data of actual modes of movement in person trip surveys (urban region PT survey) are important, which grasp the activity and movement of each individual in the city, including the attributes, purpose, and means of transport as well. Besides, models for estimating changes in future

activities are also important. However, the problem is that the implementation of surveys and the building of models entail a lot of cost, and in particular there has been a situation in which the application in local urban regions is unlikely to be advanced. Our Division is engaged in the development of a standard activity-based simulator (ABS) utilizing the nationwide urban transportation characteristics survey (nationwide PT survey), aiming at a world where a planning utilizing the data can be realized even in cities where the urban region PT survey could not be conducted until the present and in cities with financial and technological restrictions.

The standard ABS¹⁾ to be developed in this research consists of a "personal data generation model" that generates the attributes information on an individual (gender and age, status of work, place of work, place of employment, with or without a driver's license, household status, etc.) by using national census data and a Bayesian network, etc. and an "activity-based model (ABM)" that probabilistically estimates the movement of each individual from the trends of the nationwide PT survey data. If input data such as the population, facilities, transportation, etc. are prepared for each city, simulation in the city is enabled by inputting the data into the ABS, and the present status estimation data can be output in a form similar to that of the trip data in the PT survey. Also, movements that reflect more regional characteristics can be estimated by compensating the ABM by preparing data of actual modes of movement such as PT survey data with a small number of samples and big data including mobile spatial statistics and others. Furthermore, by changing the values of the input data, simplified analysis of a future scenario is enabled, such as population concentration and improvement of transportation services.

It is considered to be a useful material when examining the direction of the problems, policies and measures such as wide-area road networks in urban regions, arrangement of urban functions, and public transportation, and an ABS of the prototype version was completed and its rental services to those who wish to use it was started in October 2024²⁾.

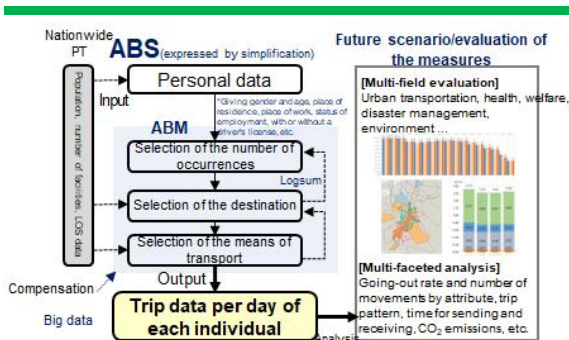


Fig.-3 Overall view of the ABS utilizing the nationwide PT survey data

3. Case of ABS application: analysis of a future scenario in the urban region of Yamagata

For the purposes of technology verification and the building of an illustration of utilization, the ABS was applied to Yamagata where an urban region PT survey was conducted in 2017, the reproducibility of the present status estimation data was verified and a future scenario was analyzed.

Regarding the present status estimation data, 2 patterns of output results in the case of applying the ABS as it is and in the case of compensating the data with the data of actual modes of movement in the urban region of Yamagata were compared with the PT survey data in the urban region of Yamagata, whereby the performance of the simulator without compensation was verified, and at the same time the validity of the method of compensation was also verified. As for the data of actual modes of movement, the trip pattern, destination, and means of transport data of the PT survey with small samples and the de facto population data of mobile spatial statistics were utilized. Consequently, it has been verified that the tendencies of the characteristics of movement in the entire urban region such as the going-out rate, the number of trips by purpose, and the modal share can be expressed even before compensation, and that by compensation the characteristics can be made closer to the actual modes of movement in the city.

Regarding the analysis of the future scenario, it has been examined in 2 patterns: change in the city structure and change in the public transportation 20 years later. In the analysis of the city structure scenario, it has been shown that evaluation can be made from a variety of viewpoints such as the sustainability of the city (maintaining the number of trips to the central city area, etc.), change in the way of life (improvement of the going out rate of the elderly), etc., concerning the case where the current problems have advanced and the case where urban transportation measures have been taken such as the Compact Plus Network, etc. Regarding the analysis of a public transportation scenario, analysis has been made on changes in the effects depending on the differences in the applicable area and the content of the measures including the introduction of the main transport such as BRT and the introduction of regional transport such as demand-responsive transport, from multi-faceted aspects such as the place of residence of people, destination, purpose and the attributes of users.

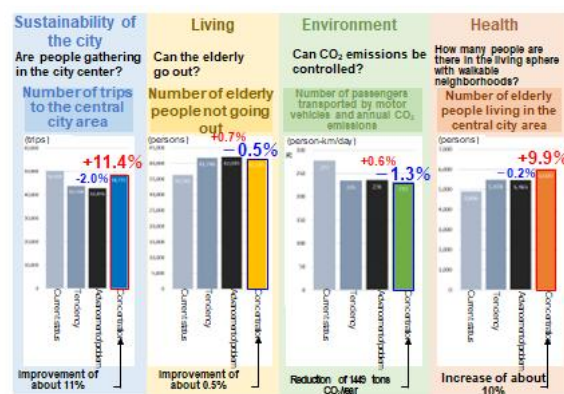


Fig.-4 Example of expressions in multiple fields of the results of analysis of the future scenario

4. Scenes of nationwide utilization of the ABS

Scenes of utilization of the ABS can include those in which local public entities efficiently grasp the current status of the movement of people in order to review the city structure in future, or carry out analysis of a future scenario in order to examine the order of priority of the areas of implementation of public transportation measures, when examining the comprehensive transportation strategy or a regional public transportation plan, location optimization plan in the next period. In particular, during times with many uncertain factors where prediction of the future is difficult, scenes can be assumed where various scenario patterns in the future are examined at low cost, speedily and efficiently, and also, the number of people in the living sphere with walkable neighborhoods, the number of passengers transported by motor vehicles and the annual CO₂ emissions thereby, as evaluation indexes related to the transportation behavior data of people, in multiple fields including health and welfare, environment, industry, disaster management, and others.

5. Toward the full-fledged operation of the ABS

In future, we will aim at full-fledged operation (publicizing) of an ABS that has higher practicality and is easier to use, while seeking the nationwide propagation of the ABS by accumulating and publicizing case studies, and through the expansion of functions by means of a combination with various types of simulators that represent multi-modal movement and the locus of movement in each route, as well as rebuilding of models by means of the next period nationwide PT survey (FY 2025) data, and others.

For more detailed information, visit:

- 1) Technology verification report (October 2024 initial version) <https://www.nilim.go.jp/lab/jcg/pdf/committee-2/gjyutukennsyurepoto.pdf>
- 2) Press release: Opening of the specially established website of the Urban Facilities Division & invitation to the use case development fields (October 11, 2024) <https://www.nilim.go.jp/lab/bcg/kisya/html/kisya20241011.htm>