学位論文の要旨（論文の内容の要旨）
Summary of the Dissertation (Summary of Dissertation Contents)

論　文　題　目
Dissertation title

The Multidimensional Impacts of Multi-service Transport Platform (MSTP) on Activity-travel Behavior and Urban Form: A Case of Jakarta, Indonesia

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Background and Motivation

In recent years, the presence of Multi-Service Transport Platforms (MSTPs) as one of the innovations of ICT in the field of transportation and daily service provision has rapidly expanded and had a significant impact on our daily activity. Daily activities and travel are inseparable since travel is the result of an individual's desire or need to engage in an activity. While the location to perform activities is spatially distributed over a wide range of areas. Hence, these activities cannot be carried out at the same location. Then, the result is the desire to conduct some trip or travel to another location. With this realization in mind, this thesis had presented the result of an analysis that examined the multi-dimensional impact of MSTPs on urban form and activity-travel behavior.

An empirical study was conducted to assess the impact of MSTPs on urban form through the agglomeration index analysis of facility distribution across a different scale and different type, underlying the distribution of facilities in Jakarta. The relationship between the agglomeration index and city-level characteristics has been added to give a more comprehensive impact of MSTPs on the urban forms. The activity-based approach was adopted in this study since the MSTPs may affect all components of daily activity and travel behavior. Data on activity-travel patterns give a more comprehensive account of activity-travel behavior. By utilizing the dynamic discrete choice model's framework into our analysis, the approach allowed us to examine the impact of MSTPs on the user's activity-travel pattern.

The existing activity-travel behavior research does not consider the presence of ICT, particularly MSTPs in the existing activity-based analysis framework. One of the reasons is due to the limitation in the availability of online activities data (i.e., MSTPs). The study that exists has typically focused on single aspects of travel behavior (e.g., work commute) as opposed to comprehensive activity-travel patterns. Moreover, the existing studies, both national and international, have rarely attempted to systematically assess the impact of MSTPs on the urban form and activity-travel behavior.

Research Objective and Questions

This thesis aims to provide a comprehensive understanding of the impacts of MSTP and examine them empirically based on a case study in Jakarta, Indonesia. The specific objective is to assess the impact of MSTP in Indonesia on urban form and activity-travel behavior. In this study, three research questions regarding the impact of MSTPs are included:

(1.1)　How to quantify the concentration of facility distribution?
(1.2)　How is the association between facility distribution and city-level characteristics?
(2.1)　What distribution changes do MSTP bring about on the facility distribution?
(2.2)　How do these induced changes in urban form?
(3.1)　How to capture the virtual activities on daily activity-travel behavior?
(3.2)　How MSTP change the distribution of activities?

(3.3) What factors that influence people to choose online activities?

(4.1) How the presence of MSTP's online food delivery service will affect people's eating behavior?

(4.2) What factors that affects MSTP's service level?

(5.1) How to extend the current dynamic discrete choice model for activity-travel analysis to incorporate the impact of MSTP use on activity-travel pattern?

Methodology

In this study, to analyze the impact of MSTPs on the urban form, we analyze the spatial distribution of facilities through agglomeration index analysis and its correlation with the city-level characteristics. We employ the agglomeration analysis across the different scales of the area and different types of facilities. With regards to analyzing the impact of MSTP on activity-travel behavior, both revealed preference (RP) and the probe-person (PP) data are collected to capture the current activity-travel behaviors and preference of using MSTPs. A travel-activity diary survey was conducted in Jakarta within 14 days (from January 28th to February 10th, 2020) along with two additional questionnaires about the individual characteristics and their preference of MSTPs usage, mainly, the online-based food delivery service. To achieve this research aim, we extend the dynamic discrete choice model by adding the component of MSTPs to assess the impact of MSTPs on activity-travel behavior.

Data

To analyze the impact of MSTPs on activity-travel behavior and eating preference, a travel-activity diary survey was conducted in Jakarta, Indonesia. Along with two additional questionnaires about the individual characteristics and their preference for MSTPs usage, mainly, the online-based food delivery service. The data was collected from 272 individuals who complete 14 days (2 weeks) smartphone app-based travel-activity diary survey. Regarding the analysis of agglomeration, two location study has been chosen, including 69 cities in Japan and 5 cities in Jakarta, Indonesia. Using the data of commercial and public facilities to construct the agglomeration index and the city-level characteristics for the advance analysis of the relationship between the agglomeration index and transportation variable.

Main Findings

The impact of MSTPs on the urban form was analyzed through the agglomeration analysis. We found that the city's agglomeration effect will be smaller if they start to have an online food delivery service. The presence of MSTPs may lead to some changes in the city's structure due to their tendency to be agglomerated to cope with the minimum number of users, and food merchants' partners in some areas will attract the driver to come and get around those areas to provide some delivery. The MSTPs may encourage people to be in the central area to get more range of the service, and it also may encourage the food merchants to be agglomerated and generate new service zones anywhere. MSTPs service relies on the spatial interaction among food merchants as the supply side, among the users as the demand side, and the spatial interaction among the user and the food merchants. In the long run, this kind of service may lead to a less structured city due to their ability to be located anywhere if they can maintain enough supply and demand at a specific location.

The impact of MSTPs on the individual's eating behavior was made by analyzing the preferences of individuals using the online food delivery service. We found that people still feel it is quite costly to use online-based food delivery services because of their delivery time. The longer delivery time also indicates longer waiting time for customers' side, and people feel the cost for waiting for the food ordered by using MSTPs is almost the same as the cost that they need to pay if they are conducting some trip (eat-out trip). In this case, the presence of MSTPs for online-based food delivery services has a substitution effect for eating out trip. The results indicate that if the merchants decide to move to the suburban area, they will lose their previous number of potential customers in the central area because the increase in distance will increase the delivery time.

The impact of MSTPs on activity-travel behavior was not wholly assessed due to the limitation of the study. We have attempted to develop a modeling framework to comprehensively understand the impacts of MSTPs by adding the utility of using online food delivery services into the utility of staying. We introduce the model and emphasizing how the model works through the simple toy model simulation. In this simulation, all the parameter is given, while in the actual calculation, we will estimate all parameters for each action and states. Based on the simulation, we can see how the model will work and what is the outcome can be produced. By having MSTPs components in our activity-behavior model, it gives such a significant impact on the probability of the chosen path and how the pattern would be developed. In the utility of staying, the number of facilities has played a significant role as the attraction of the zones that emphasize the size of opportunities to perform an action in a particular zone. In this case, the discussion of location attraction also related to the discussion about the benefit of agglomeration. When the agglomeration is happening, we will have a much larger capacity in the zone.

Significant Contributions

The concept of Multi-service Transport Platforms (MSTPs), the part of ICT innovation, is expanded in the field of activity-travel behavior research. In particular, this study could successfully:

(1) Establish the comprehensive survey framework to capture the individuals' activity-travel behavior simultaneously with the usage of online activities and their preferences of using the online services.

(2) Propose the new approach in constructing the counterfactuals for agglomeration index analysis.

(3) Propose the new framework of activity-travel behavior modeling by expanding the dynamic discrete choice model component with the addition of the MSTPs component.

(4) Using the SP-PP survey to capture the individuals' preference can reveal the actual condition of respondents by gathering the individual activity and travel information by integrated with the GPS to collect much higher resolution data in real-time.

(5) While the agglomeration analysis was done in the aggregate scale of the area, this study provides a comprehensive analysis of the agglomeration index across area scale and facility types.

(6) Using the location of public facilities as the counterfactual, we can produce a new approach in the agglomeration index calculation.

(7) Considering the analytical procedure results, we found that IPWT can handle the bias caused by the sampling error or the survey design in the preference survey and give a better estimation result.

備考　論文の要旨はＡ４判用紙を使用し，4,000字以内とする。ただし，英文の場合は1,500語以内とする。

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