論文の内容の要旨

Abstract of Dissertation

論文題目

Managing Barriers towards Intermodality Improvement based on Provider and User Perspectives to Promote Commute Mode Shift to Bus Rapid Transit System
Case Study: Greater Jakarta, Indonesia

インターモダリティ改善によるBRTシステムの利用促進に関する研究：
ジャカルタ大都市圏通勤交通における課題と対策

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（本文）(Abstract)

Introduction

This study attempts to contribute in formulating measures to tackle worsening congestions in Jakarta. One way to solve the issue is by providing a convenient public transportation alternative which can significantly generates mode shift from private modes. Among all options of public transport modes including subway plans that have been under planning for decades, in January 2004, Jakarta chose Bus Rapid Transit (BRT), the increasingly popular alternative particularly for developing cities.

From the beginning, Jakarta intended to implement closed trunk-and-feeder system. From network point of view, trunk-and-feeder system is expected to reduce number of operating vehicles on the road and increase the number of trunk lines passengers. While from user point of view, passengers who come from outside walking distance of a shelter have to take feeder modes, commonly served by smaller vehicle, to reach the nearest BRT platform along higher density corridors. Accordingly, they must take one or more transfers between modes. Furthermore, if the nearest BRT platform is an intermediate shelter which is located on the median of a road, then the passengers should transfer through an elevated crossing bridge. Some studies confirm that the complexity while transferring in an intermodal trips involving BRT impose major attention from users.

Furthermore, a trunk-and-feeder network development is typically coupled with “closed” system business structure which requires bus sector reform both in terms of network configuration and its organizational arrangement. It is critical to provide a functioning feeder system which has become the critical success factor for Bogota’s Transmillenio system which gets its 60% of passengers from feeder buses. Unfortunately, such bold measure has not been taken for Jakarta’s case. Hypothetically, some significant barriers must have been existed that limit Jakarta system from taking as essential measure as providing an effective feeder system.

As a result, the system cannot achieve its goals either reducing the number of bus vehicles operating and competing on the road or absorbing larger share of passengers shifting from other modes. In fact the system reduces road capacity by taking two lanes for

its services. Consequently, in spite of contributing to efforts in tackling traffic congestion, it may worsen the condition even further.

Research Goal and Objectives

Thus, the study is aimed for formulating measures to manage barriers towards improvement of intermodality in Greater Jakarta, Indonesia. This issue is analyzed by taking consideration of two sides perspectives: supply side or public transport service providers and demand side or public transport (both current and potential) users.

To achieve the main goal, five major research steps are being set up:

1. Formulating the framework of intermodality evaluation through literature review related to theoretical strategies and empirical evidences on how to improve TransJakarta Busway system attractiveness through intermodality improvement;
2. Develop the expected level of intermodality to be achieved by TransJakarta Busway;
3. Identify current status of TransJakarta Busway intermodality through field observation;
4. Explore barriers encountered by providers (government and operators) in improving TransJakarta Busway's intermodality;
5. Investigate the importance of intermodality improvement in influencing commuters mode choice;
6. Evaluate the proposed measures through cost-and-benefit analysis and also explore the impact on public transportation system institutional arrangement in Jakarta.

Methodology and Summary of Results

First, it begins with literature reviews to formulate the framework of intermodality evaluation. It focuses on two weakness points of intermodal trips: (i) the availability of access and egress mode to ensure interconnectivity throughout the journey; and (ii) higher penalties for having to interchange. Some theoretical and empirical studies are reviewed and lessons-learned are summarized. Regarding the first point, two best practices are discussed, Seoul and Curitiba. Both provide the experiences on how to carry out public transportation network reconfiguration along with organizational reform which this study believed to be one of critical factor for success.

While in terms of the second point, the review is focused on the measures taken to relieve efforts in making transfer in order to reduce the penalties. The measures are categorized into three components: (i) hardware: interchange physical design including access and waiting amenity; (ii) software: logical integration of information system including intermodal route information, timetable, and real-time display; and (iii) finware: combined ticketing and common fare system including fare structure, collection process, and media. The concrete implementations of each component are described through worldwide practices.

Based on the evaluation framework, in the *second* step, it describes current status of intermodality consisting of three expected components (hardware, software, and finware) based on on-spot observation, interview (Jakarta's Local Transportation Authority, BRT Managing Body BLU TransJakarta and two related NGOs), and secondary

data. It also describes the current status of multimodal integration from institutional and financial aspect.

Third, the study explores barriers within public transport provision and operations in Greater Jakarta in relation with the effort to improve intermodality to and from TransJakarta Busway. The barriers for improving intermodality from the provider's perspective are classified into four categories as follows:

1. *Practical and technology barrier* is found in terms of physical design of the interchanges. Here, land availability is the main barrier including relatively narrow streets on some segments of the corridors enforcing the system designers to "compromise" the required station size and amenity. Further, there are also mixed traffic segments and bottlenecks at some points. It also includes lack of key skills and expertise in designing procurement contracts for private sectors in order to provide detailed engineering and construction-maintenance scheme.
2. *Political and cultural barrier* is encountered in improving service reliability in order to increase capacity, reduce long waiting time and provide effective feeder system. The barriers come from the management of conventional buses which have been developed in a bottom-up way without sufficient regulation. Furthermore, there are some "ethics" to be maintained in order to avoid social unrest. Thus, competitive tendering has not yet been realized for the current system which also becomes the barrier to develop a better public-private-partnership scheme.
3. *Financial barrier* is significant since the source of fund heavily relies on public means where subsidy increases year-by-year. Such inefficiencies are actually the result of weak management. One apparent problem is settling the cost per bus-km to be paid to the operators due to lack of accountability between BLU TransJakarta and the operators.
4. *Legal and institutional barriers*: lack of effective legal power to allow good governance practice in tendering services, enforce bus network reconfiguration to realize software and finware integration, establish firm level of service standards among operators, and establish coordination between TransJakarta authority and other public transportation.

The *fourth* step is to contribute further understanding about the importance of the expected level of intermodality improvement designed in the second step. It attempts to address the issue of whether the improvement of interchange quality through multimodal integration or intermodality, in addition to travel time, time delay and travel cost could impact to-work-commuters' mode choice through a stated-preference (SP) survey. Therefore, two phases of internet-based questionnaire surveys for investigating impacts of intermodality on to-work commute mode choice were conducted: preliminary survey on March – April, 2008 and final survey on September – November 2008. The respondents of these surveys are employees working along seven BRT corridors, either BRT users or other modes' users. There are two results yielded in this step besides some insights on the SP experiment enhancement: (i) the trip complexity changes and (ii) the importance of intermodality on commute mode choice.

From the 78 samples collected through the final survey, the average length trip using BRT is about 12.3 km. Under the scenarios given, the commuters are actually able to save in-BRT-vehicle-time ranging from 8 to 22 minutes. But due to considerable time

required to access, egress, and transfer, the total travel time is compromised. Compared to current trips average travel time which falls at 72 minutes, feeder-and-busway option can only reduce 3 minutes by applying the best scenario. The scenarios could provide 16 to 47 minutes time reduction for current BRT users. While, private mode and other public transport users hardly enjoy any travel time reduction.

As for the importance of intermodality, through the Multinomial Logit model result developed from 297 observations, it is justified that door-to-door travel time in which out-vehicle time (a function of number of transfer and three-level of transfer time) and in-vehicle time (access, BRT, and egress) were incorporated is the most influencing factor on commute mode choice, followed by time delay for BRT service. The models further indicate that the tendency of choosing current mode over the new alternative may change if all three components of proposed interchange facilities improvement are introduced. While the proposed single fare for parking, feeder, and BRT seems to have lower effect although the average travel cost that the new alternative offered was cheaper.

It is found that total travel time is valued Rp 794/min or Rp 47,640/hour, almost four times higher than the average current travel cost. While interchange improvement including multimodal ticketing system is valued 36 minutes reduction of total travel time equal to Rp 28,307. It reflects that these two attributes are considered highly influencing towards the decision to shift to BRT.

As the *fifth* and also the final step, it is aimed for evaluating possible alternatives to be implemented in order to improve TransJakarta's Busway attractiveness. It begins with developing policy options to be evaluated. The policy options are attempted to mainly compare the impacts between improving travel time through increasing BRT speed and improving the convenience to interchange which is highlighted in this study and determined by considering limitations encountered by providers. For the analysis, three main integrated transfer points are selected. Afterwards, the demand for each interchange is forecasted by using the utility model estimated based on SP data and JICA-SITRAMP O-D Matrix Data (2020). Utilizing the estimated demand, cost-and-benefit ratio is analyzed. Additionally, institutional arrangement required for realizing those alternatives is discussed.

In terms of modal share, improvement of BRT speed to 24 km/hour increases the share of BRT by almost 7% from 3.34% in base-scenario. Larger share is resulted from improving BRT speed to 27 km/hour at about 15% compared to interchange improvement at about 13%. Based on the benefit-and-cost ratio, improvement of interchange is slightly higher than improving BRT speed to 27 km/hour but the result shows that all options are economically viable since the ratio is more than 2. However, the load factors show that improvement of interchange offers more reasonable load factor than improving BRT speed to 27 km/hour.

The result of benefit-and-cost analysis confirms three measures essential to be implemented to improve the attractiveness of TransJakarta Busway: (i) capacity enhancement; (ii) feeder provision; and (iii) interchange convenience improvement. These measures have several impacts on institutional arrangement since they are difficult to be achieved under the existing arrangement.

It is recommended to divide the authorities into strategic, tactical, and operational level in order to establish a more efficient decision making process. In line with the

ongoing progress of railway sector enhancement, an intermodal transport authority in order to realize software and finware integration is emphasized, as well as strengthening BLU TransJakarta. Both elements are working together at tactical level.

One problem that may occur is fleet provision as evidently shown by the current system. Public financing is likely to be the last solution expected. It is recommended to establish horizontal separation between fleet provision and its maintenance-operation. The operators can rent the fleets from fleet company. It can further be applied for feeder system by furbishing the existing conventional buses.

In terms of feeders, it is proposed to accelerate network reconfiguration for increasing interconnectivity to BRT network and to minimize number of transfers. However, learning from best practices and current problems faced by Jakarta's bus industry, Jakarta should also emphasize on favoring a healthy atmosphere among operators in delivering services and promoting cooperation towards integration through introducing controlled competition throughout the whole bus industry.