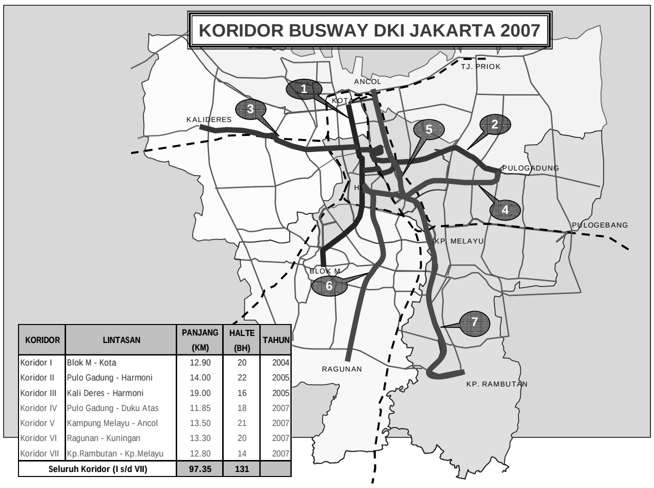
BARRIERS TOWARDS INTERMODALITY FOR PURSUING TO-WORK COMMUTERS MODAL SHIFT TO BUS RAPID TRANSIT SYSTEM IN JAKARTA, INDONESIA

Puspita Dirgahayani[1]
Noboru Harata[2]
Nobuaki Ohmori[3]

INTRODUCTION

The introduction of seven corridors of Bus Rapid Transit (BRT) System, TransJakarta Busway, since January 2004, has delivered Jakarta, Indonesia, to the new era of transportation tradition. Over the years, Jakarta Metropolitan Area (JMA)'s commuters have already accustomed to multimodal trips reflected by the figure that almost half of total trips made in JMA need two modes or more to terminate a trip from origin to destination (BAPPENAS-JICA, 2004). Nevertheless, the tradition of alighting, boarding, and transferring in the designated interchange points can be considered to be new. Moreover, closed system with stops located on median is deployed requiring passengers to take separate-graded crossing to access the platform.



KORIDOR	LINTASAN	PANJANG (KM)	HALTE (BH)	TAHUN
Koridor I	Blok M - Kota	12.90	20	2004
Koridor II	Pulo Gadung - Harmoni	14.00	22	2005
Koridor III	Kali Deres - Harmoni	19.00	16	2005
Koridor IV	Pulo Gadung - Duku Atas	11.85	18	2007
Koridor V	Kampung Melayu - Ancol	13.50	21	2007
Koridor VI	Ragunan - Kuningan	13.30	20	2007
Koridor VII	Kp.Rambutan - Kp.Melayu	12.80	14	2007
Seluruh Koridor (I s/d VII)		97.35	131	

Figure 1: TransJakarta Corridors Established Until 2007 (DisHub, 2006A)

[1] PhD Candidate, [2] Professor, and [3] Lecturer, Urban Transport Research Unit, Department of Urban Engineering, University of Tokyo, Japan

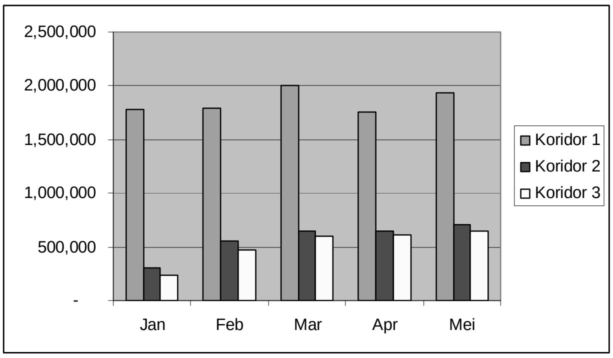
By 2010, Jakarta is planned to have fifteen corridors of busway. Until 2007, seven corridors have been established and operating shown in figure 1 and the characteristics are listed in Table 1.

Table 1: Characteristics of Corridor I – VII

CORRIDOR	ROUTE	LENGTH (Km)	NO. OF STATIONS	BUS TYPE	NO. OF FLEET
Corridor I	Blok M - Kota	12.90	20	12 m standard diesel	90
Corridor II	Pulo Gadung - Harmoni	14.00	22	12 m standard CNG	55
Corridor III	Kali Deres - Harmoni	19.00	16	12 m standard CNG	71
Corridor IV	Pulo Gadung - Dukuh Atas	11.85	18	12 m standard CNG	34
Corridor V	Kampung Melayu Ancol	13.50	21	18 m articulated CNG	30
Corridor VI	Ragunan - Kuningan	13.30	20	12 m standard CNG bus	54
Corridor VII	Kampung Rambutan - Kampung Melayu	12.80	14	12 m standard CNG bus	85
	Total	**97.35**	**131**		**419**

Source: TransJakarta Management Board (BP TransJakarta), 2006

For the first three corridors, the number of passengers per weekday is 20,000 (corridor II and III) to 75,000 (corridor I). On weekends, the passengers for corridor II and III are not quite different from weekdays, ranging between 18,000 to 20,000 passengers. On the contrary, on corridor I which is dominated by office buildings, the number of passengers on weekends falls to about 4,600 – 4,900.



Source: Annual Evaluation Report, DisHub, 2006A

Figure 2: The Fluctuation of Patronage in Corridor 1, 2, and 3 in 2006

Based on a passenger survey conducted by Jakarta's Communication Agency or DisHub (2006), the majority of busway passengers used to use large/medium buses for about 59%, while those who shifted from private car or taxi were 11%. The reason for using busway was shorter time (65%), followed by comfort (20%). The problems encountered by TransJakarta are service insufficiencies, particularly long queue at the station (41%), long waiting time (45%), unclear departing/arrival time (37%). High number of interchanging required in a trip involving BRT is indicated to be the main reason why people in JMA become reluctant from using BRT, followed by longer travel time and the difficulty to access busway stations (DisHub, 2006A).

Hidalgo et al. (2007) also evaluated that TransJakarta's basic infrastructure, equipment designs, and operational concept, such as small stations, inefficient terminal design, concentration on few transfer points, independent operation of each corridor, and also inefficient management of fare collection have led to negative ratings of the users. Furthermore, TransJakarta is obviously operating without functioning feeder system due to institutional problem which in fact should be prioritized and has become the critical success factor for Bogota's Transmillenio system which gets its 60% of passengers from feeder buses (Hook, 2005; NBRTI, 2006). These problems resulted in low degree of TransJakarta's intermodality which is important to attract more passengers and pursue modal shift of those who currently still prefer to use private cars or conventional public transport to commute.

This paper aims to seek the probable barriers encountered by the authority to provide a certain state of intermodality in TransJakarta's system. It departs from the intermodality performance evaluation of TransJakarta's system based on a framework synthesized from a review on the influence of intermodality on commute mode choice in general which is further narrowed into JMA's commute mode choice characteristics and what measures have been adopted by other countries in order to enhance intermodality. The current state of intermodality of each components is followed by its challenges based on on-spot observation, related secondary data and studies, and further discussed referring to the result of in-depth interview with representatives of DisHub, TransJakarta Management Board or BP TransJakarta, and the two related NGOs, Pelangi Foundation and Institute for Transportation Studies (INSTRAN).

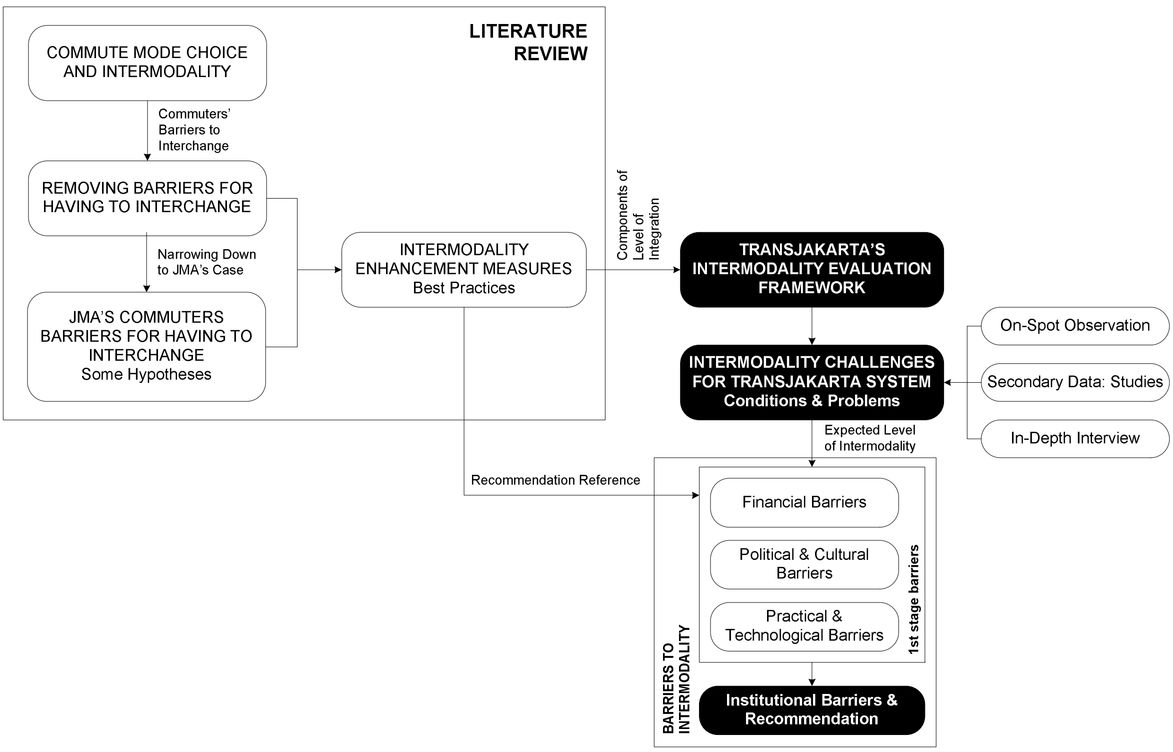


Figure 3: Objective and Methodology

COMMUTE MODE CHOICE AND INTERMODALITY

Commute mode choice has been an interesting field of research in order to formulate effective measure in reducing car use and improving public transport attractiveness. There are at least three important dimensions in commuter travel decision that have been consistently found: (i) travel time reliability; (ii) travel cost affordability, and (iii) more recently, the need to make trip chaining as people's activity pattern become increasingly complex and involve interactions with other household and non-household members and as time is a finite resource (Hensher and Reyes, 2000; Bhat and Sardesai, 2006; and Ye et al, 2007). These three dimensions apparently provide advantages to car usage which also facilitates a person's need for flexibility and speed in their daily life and their "sensitivity" to their "personal travel experience" (Cambridge Systematics in Hoffman, 2005). Thus, it is unsurprising most of commuters prefer to drive alone to work when they have inflexible work schedule and when they have to make a stop during commuting or midday on weekly basis (Bhat and Sardesai, 2006).

On the other hand, by carrying out a trip using public transport, these three dimensions are compromised. Travel time reliability and the need for trip chaining during commuting are challenged by the need to interchange which consequently is associated with more costs. For commuters who do not need to make intermediate stop(s) between their home to work may need to interchange from home to access mode, feeder mode, trunk mode, and at last egress mode to workplace, while commuters who need to make intermediate stop(s) additionally are required to stop at an interchange, leave the paid area, and re-enter the interchange to complete their trip to workplace. If the intermediate stop(s) involve other dependent person(s), for example kids to be dropped off, interchanging becomes more complex. Besides extra actual cost in terms of fare and time, it also generates perceived costs (Hein and Scott, 2000) which include physical (walking, waiting, and carrying efforts), cognitive (collecting and processing information effort), affective (emotional burden such as delays, lack of information, route unfamiliarity, uncertainty, personal security), and stress (time pressures).

Hence, it is reasonable that most commuters prefer to use cars. Even for those who use public transport are tend to avoid interchanging which involves transfer between vehicles and prefer a trip with at least only one time transfer with the fastest and more direct route (Wardman et al., 2001; Zhao, 2006). It indicates that barriers for having to interchange exist. MIMIC project study's result (2000) shows that most interchange users in Europe consider poor information on service delays is the most important barriers, followed by poor information for journey planning and queuing for tickets. While for disabled people, access to vehicles and access to information are the main determinants, followed by long distances between modes and inadequate lighting.

REMOVING BARRIERS FOR HAVING TO INTERCHANGE

The measure to remove such barriers is by improving the utility of having to interchange experienced by the passengers. Wardman et al. (2001), regard the utility of having to interchange as having three principal components:

- A requirement to interchange which has a penalty associated with: (i) inconvenience of having to change vehicles; (ii) expected additional waiting time which depends on the probability of missing the connection and the wait time until the next service along with the reliability of the connecting service; (iii) expected difference in comfort (type and standing requirement); (iv) non-linear effects, for example difference between the first ad the second interchange; (v) position in the journey where the interchange occurs which could impact on the perceived penalty of having to interchange; and (vi) transaction costs of interchange relates to the gathering information, financial handicap, or time penalties of rebooking. In addition, costs associated with integration between modes should also be included.

- Transfer time value: depends on the nature of the transfer (requiring crossing or not, pedestrian ways amenities, the availability of ramp/escalator/elevator) and the amount of transfer time.
- Waiting time value: the comfort of interchange location, the security of the interchange location, the opportunities for engaging in worthwhile activities, and the amount of waiting time.

The utility of interchange can be increased through integration (Stokes and Parkhurst, 1996). ISOTOPE (1997) classified integration into three types: physical, tariff, and logical (user perception) integration (Viegas, 2005). Physical integration is reflected by the interchange design, network integration, properly coordinated timetable, and integration with land use (TOD). While tariff integration is obtained by the tariff system between modes and/or common media used. Further, logical integration means that users should be able to perceive the services as a whole unit through a well-integrated with common design and language of information system to reduce uncertainties and risks associated with any interchange process. While Janic & Reggiani (2001) specified four level of integration, hardware integration (terminals), software (information system), orgware (better coordination of timetables), and finware (combined ticketing and common tariff system). Quality indicator of the level of integration allowing at least two different modes to be used in an integrated manner in a 'door-to-door' transport chain at an interchange is defined by European Commission (EC) as 'intermodality' (Janic & Reggiani, 2001).

JMA'S COMMUTERS' BARRIERS FOR HAVING TO INTERCHANGE

This paper departs from the barriers of having to interchange considered by to-work commuters. Commuters have inflexible schedule and usually have already determined their preferable route to take everyday. Further, to-work commute may prefer a journey with less physical effort to be able to proceed with their whole day activity or after a long day tiring activity.

Further, regarding modal shift target, in general, there are two groups to be emphasized in the analysis, the conventional bus users or train users which routes overlaps with TransJakarta's corridor and provides direct routes to workplace and the private mode users. Based on SITRAMP study (BAPPENAS & JICA, 2004), security is the most distinguished factor when JMA's residents select their travel mode, followed by comfort, cost, and convenience. Speed is surprisingly the last consideration. It indicates that time unreliability or schedule inflexibility is not a significant constraint eventhough further study is required. As income level grows, JMA's residents attach greater importance on security, and less on cost.

Yagi and Mohammadian (2006) developed activity-based microsimulation models for JMA based on SITRAMP data and found similar result. Generally, the utility of auto and taxi increase as the income becomes higher, while the utility of motorcycle, transit (with non-motorized access), and non-motorized transport increases as the income becomes lower. Furthermore, gender and age also play more active and distinct roles in the models. That is males have greater utilities of private modes, while females have greater utilities of taxi and transit. In addition, older people have greater utilities of private modes including taxi rather that non-motorized transport or transit.

INTERMODALITY ENHANCEMENT MEASURES BASED ON BEST PRACTICES

Best practices on ‘intermodality’ have already been demonstrated by many rail-based systems throughout the world, particularly reflected by the design of world class interchange facilities. Thus, in spite of concentrating on best practices of closed-BRT system style ‘intermodality’ which are still new and few, this review is also taking examples from rail-based systems in complementary. Besides the feature of ‘intermodality’, this part also discusses the common barriers that these best practices encountered and in some cases how to minimize the barriers.

Hardware: Interchange Physical Design

To be able to pursue more modal shift, an interchange point should be designed to facilitate the following ‘intermodality’ objectives (TfL, 2001; Van de Velde, 2005; Chisholm-Smith et al.; 2006): (i) minimizing time for changing between modes; (ii) providing infrastructures/facilitation allowing smooth and secured multimodal transfer; and (iii) providing amenities for waiting for next service. For these three objectives, two aspects of interchange design are emphasized, the access amenity and the waiting amenity.

Interchange access amenities for reducing physical efforts and transfer time

- Parking facilities for kiss-and-ride, park-and-ride, bike-and-ride, taxi, and paratransit in 5 – 10 minutes walking distance, pedestrian ways amenities from train station, and bikeways throughout the city (Hein & Scott, 2000). Table 2 shows illustrations for park-and-ride and paratransit parking facility.

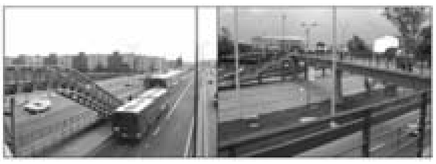
Table 2: Parking Facilities Illustration

Parking Facilities	Illustration from Other Countries
Park and ride located in the suburbs with its proximity from residential areas, e.g. Brisbane on the left (courtesy of Brisbane Busways) and Bangkok Skytrain on the right (photo by Llyoid Wright in Wright, 2004)	 
Integration with paratransit modes e.g. mordenization of pedicab in Bogota (photo by Llyoid Wright in Wright, 2004))	  

- Based on a survey on P&R/Pool Facilities (TCRP Report 95, 2004), indicators of success are summarized as: (i) provision of connecting services with high frequencies; (ii) strategic locations; (iii) attractive fare or even free; and (iv) absence of unmitigated security problems, real or perceived. It is also important to comprehend that the users of P&R facilities will be characterized as “choice” users, not “captive” to public transit, and also not generally “captive” to their auto. Thus, the users must have reasonable incentives to make the expected choice. The major ones are saving money, saving on driving stress, and saving time (TCRP Report 95, 2004).

- Pedestrian linkage amenities accessing BRT ramps

Table 3 – Pedestrian Linkage Amenities Illustration

Pedestrian Linkage Amenities	Illustration from Other Countries
Covered or park-environment designed pedestrian ways e.g. Panama City (photo courtesy of Lloyd Wright) and Guangzhou (photo courtesy of Michael King) in Wright, 2004	 
Weather protection - Pedestrian ways are protected from intense heat and storm rain (e.g. Brisbane South East Busway photo courtesy of TransLink)	
Ramps, escalators, or elevators – The overpass or tunnel should be accessible to a person in a wheelchair, a person pushing a baby carriage, a person with packages or other large things to bring, or one who has trouble climbing stairs; if elevators are used, stairs must also be provided for circumstances when they are not functioning e.g. Bogota (Wright, 2004) and Tokyo (photo by Dirgahayani)	 
Illumination – Overpasses and tunnels should be well-lit; otherwise, evening usage will fall dramatically e.g. Nagoya, Bogota (Wright, 2004)	 
Visibility – There should be clear lines of sight between the bridge or tunnel, station and street; without clear sight lines, pedestrians will fear that criminals are lurking in hidden spaces e.g. Bogota (Wright, 2004)	

- Interchange signage and general routeway information including locality maps and interchange maps.

Table 4: Interchange Signage and Routeway Information Illustration

Interchange signage and general routeway information including locality maps and route maps highlighting interchange opportunities e.g. Tokyo (courtesy of Dirgahayani), Brisbane (courtesy of TransLink), and London (courtesy of TfL)	

Interchange waiting amenities to provide opportunities for waiting passengers to spend worthwhile daily activities

- **Inside The Interchange** – Space for queuing, air-conditioned seating facility, trash cans, restrooms, kiosks, newspaper stands, and public phone.
- The places were travellers pause must be functional and similar to both the shape and the layout of the overall structure. They must also be clean, comfortable, air-conditioned, safe, and have good access to kiosks, newspaper stands, toilets, public phone, or other facilities. The place can be an exclusive room like the one shown in the picture below (Tokyo) equipped with automated sliding doors and air-conditioner, or simple seating facilities. The restrooms in Tokyo's train stations are also equipped with facilities for persons with wheelchair (special designed toilet and Braille signs), and for babies. Unlike train stations which usually are more spacious, BRT stations, particularly those located on road median, space is a significant issue. Therefore, minimum requirements for smooth transfer in a BRT interchange facility are simple but convenient seating facilities and well-manage queue lines. Seating and trash containers are among the most common amenities incorporated at bus-based system stations. BRT system with more complex stations, such as Pittsburgh, includes more amenities such as heating, public address systems, and emergency telephones (FTA, 2004). Others will depend on the size of interchange facility or can be provided outside the interchange.

Figure 4: Exclusive Waiting Room in Train Station in Tokyo

- **Outside the Interchange** - Integration with surrounding land use reflected by the availability of commercial, public, and other daily activity facilities with convenient access in order to accommodate passenger's intermediate stop(s).

Based on comprehensive review of 26 case study cities implementing BRT system, Levinson et al. (2003) concluded that any major BRT investment should be reinforced by transit-supportive land development and parking policies. Yet, whether TOD can be associated to BRT system is questionable (Currie, 2006). However, it is believed that BRT projects can provide a catalyst for TOD where a transit station can be a nucleus of a transit centre, or so-called urban village (Wright, 2004), as proven in Bogota, Curitiba, and Ottawa (Levinson et.al, 2003).

Curitiba is one of the best examples for Bus TOD. Curitiba has sought to exploit the advantages of clustering – commonly used businesses and public services located in an urban village – in conjunction with its BRT stations by developing "Citizenship Street". These streets are a mix of shops as well as key public services such as health care, counselling, employment services, gymnasiums, and libraries with convenient pedestrian ways as shown in Figure 5.

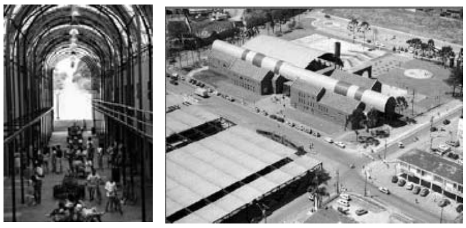


Figure 5: Curitiba's Citizenship Street Concept at Interchange Facility

(photo courtesy of Curitiba Prefeitura Da Cidade)

In developed countries like U.S. (TCRP Synthesis 67, 2006), a significant institutional barrier can be the transit agency's policymaking board. Many transit boards do not view land use planning as their role, and involvement is contentious land use decisions is not desired. Another institutional barrier is the normal division of responsibilities between transit agencies and local government. The transit agency is typically responsible for service provision and service planning, whereas land use policy and planning is the responsibility of local government. Whilst absolute barrier is financial challenge for large TOD projects that some lenders are reluctant to finance new types of projects (Cervero and Seskin, 1995), though some cases proved in contrary (Dunphy et al, 2003). However, projects are more likely to obtain financing if some local financial support is provided. Furthermore, the challenges from stakeholders who may have different interest from transit agencies, such as developers, transit operators, community, or even the local municipality.

Software: Logical Integration of Information System

Logical integration of information system is important to reduce cognitive efforts required by passengers in comprehending multimodal transit network. It is essential for passengers to perceive the multimodal system as 'one' through unified concepts and common language (Viegas, 2005). Passenger requires information on public transport trip in at least two stages pre-trip and at interchange information system.

Pre-Trip Information System

At pre-trip stages, passenger can access information through leaflets, newspapers, cellular phone, or internet. Kenyon and Lyons (2003) distinguished pre-trip traveler information provision in three types, Unimodal Traveller Information (UTI), Multimodal Traveller Information (MTI), and Integrated Multimodal Traveller Information (IMTI).

- UTI is traveller information provided within a particular information service, relating to a single mode of travel. UTI ranges from low tech paper timetables and road atlases to dynamic itinerary planning facilities or real time service information. UTI may integrate information about a number of operators, but it is limited to providing information about a single mode.
- MTI is traveller information on more than one mode of travel, within a single source. MTI services are, in effect, a series of UTI services housed together, within a single website, or available via a single telephone number. For example, the London Transport website in the UK (see http://www.tfl.gov.uk/) provides access to information about buses, the underground, river, and light rail services via a single website; and Nottingham Travelwise (see http://www.itsnottingham.info/), which provides access to itinerary planning, real time and static information to help users travel by both public and private transport modes.
- IMTI which provides information about more than one mode of travel within a particular information service. IMTI presents the user with information concerning different mode choice options in response to a particular journey specified by the user. IMTI has been demonstrated in Japan, through numerous websites which offer interactive tools to look up timetable for Japanese trains and airplanes, such as Hyperdia (Japanese and English), Jorudan (Japanese and English), Townpage Route Search (English), Ekikara (Japanese), Ekitan (Japanese), Yahoo Japan Transit (Japanese)[2]. These websites can be used to look up routes, times, and fares between two stations required by users. The results are displayed in a user friendly way and provide some alternatives based on level of fare and travel time. Some of the websites add the information with maps, hotels and restaurant, and even seat availability.

At-Interchange Information System

At interchange station, passengers may expect information through real-time passenger information (RTPI) display, route maps highlighting multimodal interchanging opportunities, timetable, and manned/unmanned information kiosks served by trained staff on multimodal information.

(i) RTPI displays provide passengers with information on estimated time of arrival of their vehicle via a passenger information display (PID). Internationally, RTPI displays have been widely used to provide transport information for bus, trolley bus, and light rail passengers such as in London, San Francisco, Adelaide (Caulfield and O'Mahony, 2007; Taylor, 2006), for BRT passengers at some stations of Bogota's TransMillenio (NBRTI, 2006), as well as for railway passengers at most Tokyo's stations (Ito, 2006)

(ii) Route maps highlighting multimodal interchanging opportunities which should be displayed in prominent location, be legible, and kept up-to-date. TransMillenio provides quite complex route maps at stations informing trunk and feeder routes available throughout the city. It is a good example for BRT system, even though the

[2] The details of webpages can be seen in http://www.japan-guide.com/e/e2323.html

map is considered to be too complex and require considerable cognitive effort from passengers to obtain their inquired information. Railway system in Tokyo also provides quite outstanding route maps as shown above displayed in integration with name of stations, timetable, type of services (express, limited express, local), interchanging opportunities at each stations, travel time, and the number train-car passenger recommended to hop into for more convenient interchanging at certain station so that passenger can directly find stairs/escalators/elevators once they alight from the train. Through more advanced technology, Transport for London (TfL) is currently developing an easy-to-use touch-screen passenger access terminal (PAT) system that provides multimodal information together with details about how to access the transport system on-foot from the passengers' home or workplace (TfL, 2001).

(iii) Timetable information. Ceder et al (2001) point out that transport operators have numerous objectives when setting timetables, such as minimizing operator costs, minimizing user wait times, minimizing vehicle and crew allocation, determining the appropriate frequencies based on demand, and matching the schedule to crew working condition. Usually a global approach from user's perspective considers the minimization of travel and waiting (and possibly walking) times. It is a transit network design approach, which accounted for origin-destination data. Nevertheless, the minimization of passenger wait times an often conflict with a requirement to minimize vehicle and crew requirements since the former requires that vehicles spend time waiting whilst the latter requires faster speeds and shorter waiting. In many cases, poor vehicle and crew utilization can be more a direct concern of operators than passenger waiting time because it is a more direct and tangible factor which affects financial performance (Currie and Bromley, 2005).

(iv) Information kiosks are manned/unmanned structures that provide passengers with information on public transport which can be equipped with RTPI displays and route maps to provide passengers with an integrated source of information. (Caulfield and O'Mahony, 2007; TfL, 2001).

- In Gothenburg, unmanned kiosks with RTPI displays were installed in 1996 which have been upgraded in 2000. The kiosks have been strategically paced adjacent to transfer points to facilitate passengers using more than one mode or service to complete their journey.
- In San Antonio, TX, since 2000, 40 utilized information kiosks have also been provided in various locations around the city. The kiosks also provide information on traffic conditions as well.
- In London, London Underground provides Customer Care Assistants (CCA) located in ticket halls at several of its busiest interchanges including Victoria and Earl's Court. The CCA is employing well-trained and friendly staffs providing passengers information about public transport in local areas. The staffs do not sit in an office or kiosks, but walk-around the interchange to offer information.

Finware: Combined Fare Payment Media and Common Fare System

Finware integration consists of three principal components which will allow enhancement to patron convenience and less transfer time: (i) fare collection process; (ii) fare payment media; and (iii) fare structure.

① Fare collection system which is how the fare is physically paid, processed, and verified can be classified into two types, off-board and on-board. On-board fare collection system is usually used by bus-based system through fare box or ticket processing unit or by commuter rail through conductor validation. While, off-board system is, at first, employed by most rail-based system, either heavy-rail or light-rail. But recently, the system is also employed by BRT system. Most of these systems use turnstiles or fare gates which are highly recommended for high-demand services. But when the station or platform configuration is infeasible to install fare gates or establish a clearly defined paid area, such as in most LRT system in North America (TCRP Report 80, 2002), in spite of using barrier system, they use self-service barrier fare collection (SSFC). For the validation, SSFC use hand-held reader and more labour force than fare gates system. The choice made can influence a number of system characteristics including service times (dwell time and reliability), fare evasion and enforcement procedures, operating costs (labour and maintenance), and capital costs (equipment and media options) (FTA, 2004).

② Fare payment media is available in four types, (i) cash (coins, bills, and tokens); (ii) paper-based (tickets, transfers, and flash passes); (iii) magnetic stripe pass (time and value based); and (iv) smartcard (contact and contactless).
Nowadays, smartcard is becoming more popular being employed in rail-based system and also BRT. Smartcard uses a plastic card containing computer chip and antenna device on which data are placed upon agency receipt of appropriate payment (TCRP Synthesis, 2003). Instead of using contact cards which require physical insertion of the instrument into the electronic reader, the more recent contactless smart card technologies' implementation for fare payment, both long and short range, is accelerating across the transportation industry. The capabilities of contactless technologies provide opportunities to allow regional payment coordination across multiple transportation modes and to process differentiated fare structures such as time-based and distance-based fare structure. Moreover, the technology has evolved to more complex interoperability scenarios through a hybrid or "dual interface" technology which can expand the application of cards beyond transit (FTA, 2004). Consequently, smartcard can have multiple functions such as acceptance of contactless back cards on buses and at fare gates, two or more transit entities arrange to accept each other's closed stored-value payment products, and acceptance of multiple-payment enabled devices (TCRP Report 115, 2006).
The choice of fare payment media can influence the service times, auxiliary uses, as well as the capital and operating costs of fare collection system.

③ To allow multi agency and multimodal transfer, fare structure can be either integrated or coordinated (HUR, 2001; TCRP Synthesis, 2003; TCRP 115, 2006; Janic and Reggiani, 2007)

- A fully integrated fare system is a singular standard of fare computations, consistently applied across all member agencies, such as consistently defined zones, discounting formulas, flat boarding rates, or vehicle transfer rate conditions.

    - Since 1979, public transport costumers in Copenhagen have enjoyed a full integrated fare and ticketing system based on zone. The system is provided for single trip and monthly pass. It also allows interchange between modes within a time frame.
    - The Dutch 'Nationale Strippen Kaart' based on zone principle, which may be used throughout the country;
    - In Bogota, users pay one flat fare for both trunk and feeder services using smartcard fare payment system. This allows free transfers and a cross subsidy between short trips on the trunk network and long trips that may include use of feeder buses (most areas served by feeder buses are low–income). This resulted in 60% of BRT passengers come from feeder buses.

- While coordinated fare system provides patrons with the ability to use a single instrument to purchase transit privileges which allow each member agency to retain its own fare structure and policies.

  - ‘Carte Orange’ introduced in Paris in 1975 covers all modes of public transport; in the meantime it has increased the use of bus system by about 36%;
  - Travelcard introduced in London in 1982 is valid for tube, bus, and rail; consequently, the use of public transport has increased by about 16%;
  - The Freiburg ‘Regional Environmental Card’ allows passenger to travel by 14 different transport companies throughout the region;
  - The ‘Rhein-Main Verkehrsverbund’ introduced in 1995 is a single ticketing system possessing a single fare structures. The system has merged 115 operators and 150 fare structures, and covered about 4 million people over 14,000 km^2;
  - The Ducth ‘Train-Taxi Ticket’ allows a traveler to pay an extra supplement of Dfl5 to transfer from public transport to a waiting taxi for the final leg of the journey; this system may be considered as an integration of individual and mass public transport system through ticketing;
  - Rechargeable contactless stored value smartcard which can be used for train and bus services have also been introduced in Asia, such as EZ-Link (Singapore), Octopus (HongKong), PASMO and SUICA (Tokyo). These three systems apply Sony’s Felica smartcard technology and allow to be used as credit card and for payment at convenience stores, fast-food restaurants, supermarkets, stores, on-street parking meters (Octopus), electronic boarding pass to airplane service (JALCARD Suica), etc. While EZ-link, Octopus cards, and PASMO are sold, distributed, and managed by a limited company, EZ-Link Ltd (an independent legal entity created under powers of Land Transport Authority and composed of public entities), Octopus Cards Limited (a joint-venture company of major public transport companies in HongKong which become private for profit corporation), and PASMO Co. (a joint-company of participating public transport companies), SUICA cards are issued by JR East and sold by three railways companies (JR East, Tokyo Waterfront Area Rapid Transit, and Tokyo Monorail) in four types of cards (SUICA card, VIEW SUICA card, Rinkai SUICA card, and Monorail SUICA card). PASMO and SUICA card can also be used as commuter pass for unlimited travelling pass between two destinations for work and school within a specified time frame (1 month, 3 months, and 6 months). Through collaboration between JR East and PASMO Co., SUICA and PASMO card can be used interchangeably but the commuters should pay attention to which companies participating in each card to ensure that they can use the card for their designated route.

Regardless to the technology used, fare payment interoperability requires significant planning and cooperation among participating agencies (TCRP Report 115, 2006), particularly in terms of management decision making processes and financial management issues in ensuring that each participant does not lose revenue through participation.

TRANSJAKARTA'S INTERMODALITY PERFORMANCE EVALUATION FRAMEWORK

Based on literature review above, a framework of intermodality evaluation is developed as shown in figure-6. First, intermodality is defined as quality indicator of removing commuters' barriers both including lower level of security, inconvenience of changing vehicle, time inflexibility, and unaffordable extra cost. The inconvenience of changing vehicle is assumed to be caused by physical effort required to interchange and the possible necessity to make intermediate stop(s), while time inflexibility would be risked by long transfer time, long waiting time, and unexpected delay when taking interchange(s). These barriers are anticipated to be removed through improving the design of (i) hardware: interchange physical design; (ii) software: logical integration of information system including timetable information (orgware); and (iii) finware: combined ticketing and common fare system. The more detailed measures of each design are defined based on other countries' achievements on improving intermodality described in the previous part.

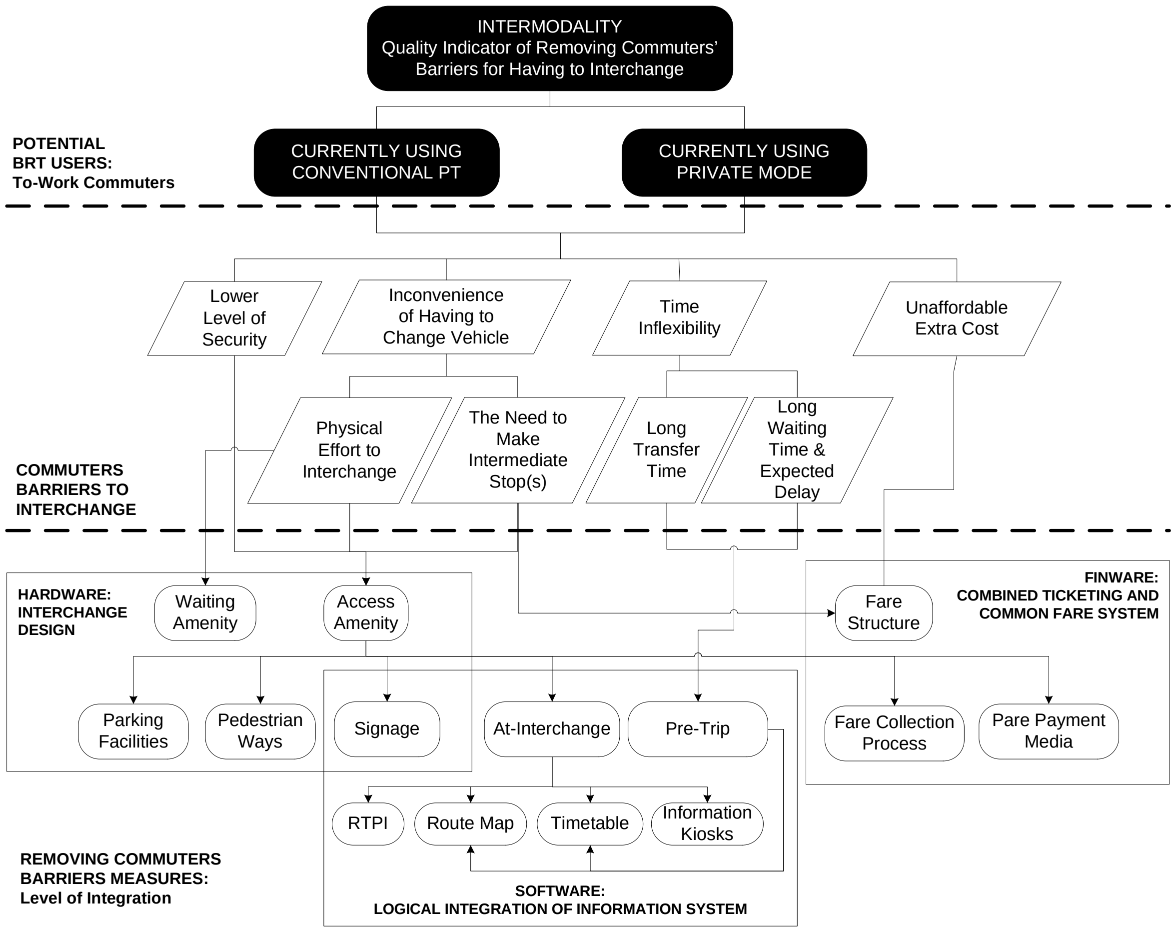


Figure 6: 'Intermodality' Evaluation Framework

INTERMODALITY CHALLENGES FOR TRANSJAKARTA SYSTEM

Hardware: Physical Interchange Design

TransJakarta's Interchange Facility Types

Basically, there are many types of interchange points or shelters in current TransJakarta's system, such as (i) end shelters or main terminals; (ii) intermediate shelters; and (iii) integrated transfer point. The evaluation focuses on end shelters and integrated transfer points where multimodal interchange occurs. End shelters are basically located at main bus terminals in Jakarta, about twice bigger in size compared to intermediate shelters.

While, integrated transfer points are classified into two types: (i) Harmoni Central Busway which is special 5 m x 78 m BRT shelter (integrating two shelters of corridor I) with capacity of 500 people to allow passengers transferring among corridor I, II, and III; and (ii) Sky Walk Paid Area (SWPA) type which allow passengers to walk on overpasses for about 200 m long connecting one BRT corridor to another. Currently, there are 3 SWPAs available: (i) Dukuh Atas (corridor I, IV, VI); (ii) Matraman Pramuka (corridor IV, V, VII); and (iii) Senen (corridor II, V, VII).

Figure 7: End Busway Shelters at Main Bus Terminals (picture 1 and 2 from left) and Intermediate Shelters

Figure 8: Harmoni Central Busway and Long Distant SWPA as Integrated Transfer Points

Interchange Point's Access Amenity

- Most access pedestrian way to the ramp is typically functional. Currently, the pedestrian way along corridor I is improved as shown in picture above and it will be continued on other corridors.

Figure 9: Typical Pedestrian Ways to BRT Ramps

- The visibility is good but the bridge design does not protect from windy rain which makes the ramps/stairs wet and slippery (see figure 8)
- No escalator or elevator available yet at most BRT stations, only ramps or stairs. Ramps are built in stations with enough land space in order to maintain climbing elevation, while steep stairs are available at stations with limited land space. One busway intermediate shelter has 2.5x2.5m elevator. The elevator is financed by private company through advertisement.
- Not all stations have sufficient illumination (DisHub, 2006A).
- Vendors, graffiti, and homeless people are common scenery around busway shelters. The enforcement is under the authority of Park and Greenery Agency apart from DisHub.

Signage and At-Interchange Information System

The signage and the maps are still few and very simple/temporary for only the trunk line route as shown in Figure 10. Best signage can be found in Ancol station, where the station is integrated to a famous northern sea-side tourism object. Another quite sufficient signage and information board is available in Blok M station, the only bus terminal integrated with underground mall in southern Jakarta. There is no information board for connecting bus routes available in BRT station. Most passengers relied on at-interchange officers to ask information.

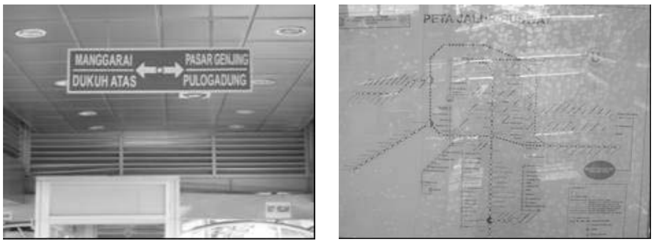


Figure 10: Simple Signage and Route Information at TransJakarta's Interchanges

Parking Facilities

- Taxi parking facilities are available only at main terminals.
- Paratransit such as pedicab, motorcycle taxi, and three-wheeled scooter are illegal but highly supplied and needed. Thus, many informal paratransit

stops, particularly motorcycle taxi (see figure 11) are available at the mouth or nearby locations of busway ramps and terminals.

Figure 11: Informal Paratransit Shelters Near Busway Ramps

Development Plan of Park-and-Ride (P&R)

Jakarta has realized the importance of P&R in encountering increasing motorization and worsening traffic congestion as well as to improve the overall public transport. Therefore, DisHub has carried out a study (2006A) and identified seven potential locations based on number of board/alight passengers and two private initiative locations, either at end points or intermediate points along busway corridors (see figure 12).

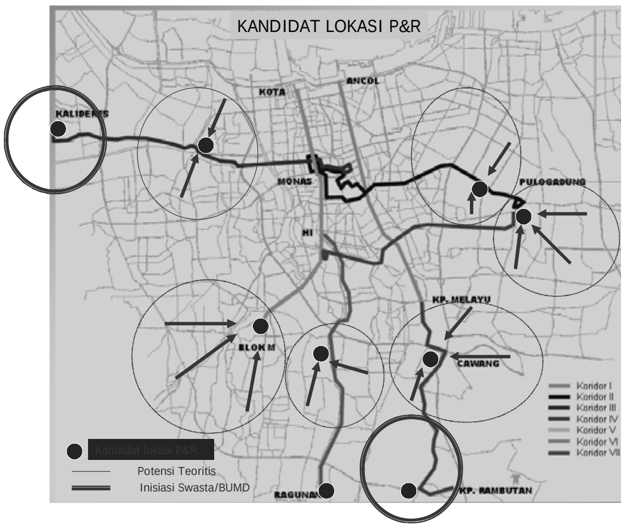


Figure 12: Park and Ride Location Candidates (DisHub, 2006B)

The end point locations would be benefited by their relatively inexpensive land prices, high demand, proximity to settlement area, and located near main terminal. While intermediate point locations would be challenged by their high land price. Nevertheless, there are some potential building owners who might willing to invest on P&R, either on-street or off-street parking facilities. Further, these locations provide more interchange opportunity for passengers and located near/at business district. For both end points and intermediate points meet the first and second indicators. The challenge is to find the most accessible spot within the areas so that the walking distance from/to busway shelters is tolerable for Jakarta's commuters.

Regarding the fare, basically it will be the same as other parking facilities fare system which is hourly based. By applying such fare system, the government is required to provide subsidies unless the management is handed out to private sectors and are awarded non-parking management concessions. On the other hand, it may be burdensome for car users leaving their cars more than 8 hours on daily basis. There should be a more attractive fare system through fare integration with busway system.

Bike-and-Ride (B&R): Bikeways and Bicycle's Parking Facility

Bike-to-work have been encouraged through the initiatives of founding Bike2Work Community and gathering more than 1,000 people who are willing to save money and also care for worsening air pollution in Jakarta. One of the bikers travel 25 km from his house in suburbs to his workplace in city centre for an average of 3 times a week using mountain bike well-equipped with biking shoes, helmet, and tight mask to protect from highly polluted air. As a result, the biker can save 90 minutes compared to car and also considerable amount of fuel money every month. Another biker can actually travel 29 km everyday without any bikeways and confronting the dangerous city traffic[3]. The bikers have already got their own preferable routes and shared them through a mailing list. A quite problematic matter for these bikers is the parking facilities. They end up asking security officers at some buildings to allow them putting their bike near the security post and ask them to look after their bikes.

This 'small' community encounters many problems to be able to use bicycle as commuter mode. Yet, they are quite persistence. It indicates the existence of a latent demand for bike-and-ride. Once the facilities available, demand will rise. The routes that these pioneers found can be followed up by the government in furnishing the bikeways. Cities in The Netherlands or other part of Europe is fortunate for being developed before the motorization which make them have the roads that wide enough for having such a convenient bikeways. It is a challenge for Jakarta with its typical narrow roads with narrow sidewalks or even unavailable to build bikeways. Recent update informs that the government first will divide pedestrian way built along corridor I for bikeways since these pedestrian is abnormally wide. Based on interview with DisHub and BP TransJakarta, the progress of improving pedestrian ways and bikeways on other corridors has not been significant.

TransJakarta's Integrated Transfer Points' Waiting Amenity

As described previously, TransJakarta's stations are too small and do not provide any waiting amenity inside the station, except simple seating facility and trash containers. Air conditioners are available at some stations. Moreover, since the width of interchange facility depends on the availability of space and the width of median, problem in accommodating the flow of passengers in some busway shelters, either on the overpasses or in the busway shelters, is occurring. Passengers' queues are not well-organized and trespass the designated line as shown in figure 13. Consequently, the automated doors remain opening and passenger safety becomes highly risked.

Figure 13: Queues in TransJakarta's Station

In order to provide better access to activities outside the interchange, it is more challenging for integrating busway station with surrounding land use. It is confirmed that for Jakarta's

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[3] Interview with Andi Rahmah, Pelangi Foundation, March 13, 2007.

case that land is a barrier for reallocating land use or establishing TOD particularly at intermediate stops which are mainly densely-built areas. Based on interview, applying Curitiba's concept is not an option yet because it requires complex partnership scheme with stakeholders, while TOD requires space which is not massively available. For now, Jakarta has integrated three busway shelters with two tourism objects' gates and extent busway ramps to second floor of one shopping mall. Jakarta intends to enhance the cooperation with the tourism objects by proposing the integration of entrance fare with busway fare.

Figure 14: Integration of Busway Station with Tourism Objects and Shopping Mall

Software: Logical Integration of Information System

TransJakarta is still operating in isolation. It is operating without integration with the existing public transport system. Software integration is likely to be a long way to go if the integrated feeder system issue is left aside. The current fixed route public transport system itself is operating without proper route map and timetable due to its remaining traditional management.

The problem basically lies on the ability of authority to firmly restructure the entire road-based public transport system and what is the political vision of providing public transport system, service-based or profit-based. Some obstacles that are assumed to be the caused of authority's indecisive approach towards the issue are:

- Public transportation is a major urban employment opportunity being relied upon an enormous community. In current industry, with its multilayer system, many opportunities have been created, such as operator company staff, cooperative staff, vehicle owner, bus driver, bus crew, 'calo' (the ones who provide service in collecting passengers at terminals or bus stops), and timer (those who notes every time each bus passes a determined spot of each bus route). All get their revenue from the fare revenue. This community is essential to be identified as detail as possible to be able to issue appropriate measures to minimize the social impacts, at least to deploy them within the sector if full trunk-and-feeder system would be an option.
- Etiquette barrier with private operators who obviously have greatly contributed in providing public transport services from scratch for JMA which makes the bargaining position of private operators seem to be high in some cases[4]. Thus, to ban and restructure existing services are suspended. Government choose to first cooperate with existing operators for joining busway consortiums of each corridor by providing subsidy based on kilometre travelled, awarding compensation in terms of 60% management entitlement with details decided by each operators referring

[4] A hypothesis proposed by Darmaningtyas (Instran).

to an SOP[5]. For other operators outside the consortium, government made some negotiation[6], such as maintaining the proximity between conventional bus shelters and arranging the distance between conventional bus shelter and busway ramp so that it is not too close in order to prevent conventional bus services lost their passengers. This way, the buses can expect passengers particularly those who prefer not to walk too far to busway shelters. At the same time, the authority does not conduct any law enforcement to force the drivers to take or drop passengers at these shelters.

Independently, TransJakarta provides route information but has not been able to provide timetable either due to unsolved problems in providing sufficient number of vehicles operating7 on some corridors and minimizing delays on some intersections8. So far, TransJakarta's buses follow the specified headways and travel schedule based on Operation Plan agreed between BP TransJakarta and the main operator for each corridor. Based on Standard of Procedure (SOP) issued by BP TransJakarta, penalty if the required headway is not fulfilled without reasonable causes in form of one round trip9 travelled kilometer cut is specified. In SOP, BP TransJakarta also regulates the first departure time (5:00 AM), last arrival time (10:00 PM), and dwell time at each station is 10 – 15 seconds.

Finware: Combined Ticketing and Common Fare System

TransJakarta employs off-board automatic fare collecting media with similar prototype as Bogota's, which is programmed to read single trip card and multi trip card. TransJakarta applies flat fare. The ticket can identify the morning peak hour discount fare. Yet, it is found that some BRT stations do not have turnstiles and do not provide smart cards as others. They use paper-based tickets and the station officer will tear the ticket to pass the gate. Different ticketing system is due to different ticket operator procuring and managing each phase of corridors' development. Such institutional scheme is insufficient for realizing combined ticketing for users' convenience. ITDP (2005) recommended establishing a single clearing centre in order to realize multimodal fare media payment integrity and flexibility.

Another problem is that the ticket/card can be purchased manually through ticket booth available at the BRT station. It may create long queue as shown in figure 15. Providing ticket vending machine at stations can be an option, as either replacement or complementary.

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5 Standard Operational Procedure issued by BP TransJakarta covering the standards for operating the vehicle, standards of drivers, standards of facilities, infrastructures, and pools, and also standards of administration procedures. It includes the sanctions in form of kilometer traveled cut for operators for not fulfilling the standards. Some aspects of infrastructures maintenance and quality have not been covered.

6Based on interview with DisHub, about the reason why the distance of some new minimalist bus shelters which are too far from busway ramps.

7 Corridor IV – VII are supposed to be served by 203 vehicles. Corridor II and III still have 18 units deficit which are still waiting for vehicle registration number (STNK). 60% or 122 units are provided by Jakarta Trans Meropolitan Ltd. (JTM Ltd.) for corridor IV and VI, and Jakarta Mega Trans Ltd. (JMT Ltd.) for corridor V and VII. The remaining 40% are supposed to be tendered to investors outside the consortiums. From 61 vehicles that are obliged to be provided by JTM Ltd., 28 units are operating, 8 units are waiting for STNK to be issued, and 25 units are being assembled. While JMT Ltd., from 51 vehicles, 19 vehicles are operating, 14 units are waiting for STNK, and 18 units are assembled. Further, 30 articulated buses designated for corridor IV, VI, and VII imported from Korea will soon be operated on corridor V.

8 Interview with representatives of BP TransJakarta and Dishub (March, 2007).

9 One time trip from departure station back to departure station.

Figure 15: TransJakarta Fare Collection Process

In the near future, one of the bank in Jakarta (Bank DKI) cooperating with the Government will issue multipurpose card which can be used as identity card, ATM card and also as payment media for BRT, expressway, taxi fare, and other type of payment. This system which is now being tested is expected to allow fare differentiation. JakCard will be issued and managed by Bank DKI. Besides JakCard, DKI Jakarta's Government is also planning to enhance busway ticket by using smartcard that can be integrated with future mass rapid transit, such as subway, monorail, and waterway.

Regarding the fare structure, based on the interview, the authority is likely to uphold the flat fare system for busway and proceed with coordinated fare structure of the future feeder system. However, coordinated fare structure with feeder system will not work without the acceptance of existing public transport (PT) operators and crews which has been experienced through current attempts. Without PT reform, the possibility of their acceptance relies upon how smooth and transparent the reimbursement of revenue between TransJakarta, PT operators, and PT crews. Management ties between PT operators and crews beyond daily rental arrangement should also be established through enforcement from the authority to PT operators.

Whilst, changing to distance-based fare remains to be an option once the entire 15 corridors are completely established. If the option is realized, DisHub is planning to upgrade the fare collection process system in order to enable distance-based fare system, such as software, tickets, additional out-bound turnstile card readers, and the programming on ticketing system which would require to be changed from 'per-trip' to 'per-rupiah' based system. However, the decision depends on political will of establishing busway system, whether it is profit-based or service-based.

DISCUSSION: BARRIERS TOWARDS INTERMODALITY

Finally, this paper reaches to the ultimate intention to discuss the barriers that limit TransJakarta from achieving a certain state of 'intermodality'. Borrowing the terminologies defined by May et al. (2003), it is assumed that institutional barriers are the ultimate level of barrier that is required to be solved which practical and technological barriers, political and cultural barriers, and financial barriers finally lead to10. The three barriers are considered to be the first stage of barriers which will be discussed first. Hypothetically, the barriers should be encountered by some measures which lead to further institutional barriers.

[10] May et al. (2003) defines and categorizes barriers as follows:

1. *Legal and Institutional Barriers*. These include lack of legal powers to implement a particular instrument, and legal responsibilities that are split between agencies, limiting the ability of the city authority to implement the affected instrument.
2. *Financial Barriers*. These include budget restrictions limiting the overall expenditure on the strategy, financial restrictions on specific instruments, and limitation on the flexibility with which revenues can be used to finance the full range of instruments.
3. *Political and Cultural Barriers*. These involve lack of political or public acceptance of an instrument, restrictions imposed by pressure groups, and cultural attributes, such as attitudes to enforcement, which influence the effectiveness of instruments.
4. *Practical and Technological Barriers*. These include land acquisition, enforcement and administration, management, and information systems, engineering design, availability of technology, lack of key skills and expertise.

Next step is to set up the level of intermodality that TransJakarta could possibly be achieved. Considering the current state of intermodality described above, it is more realistic to evaluate the barriers under a framework of modest intermodality level by emphasizing on reducing physical effort carried out by passengers to interchange, providing necessary parking facilities, minimize transfer and waiting time through finware and software improvement measures.

Table 5: First Stage Barriers and Recommendations

	CURRENT STATUS	EXPECTED LEVEL OF INTERMODALITY	FIRST STAGE BARRIERS	RECOMMENDATION
HARDWARE				
1	**Design of SWPA overpass**	**Basic Level**		For developing countries, public money is likely to be more convenient and cheaper (ITDP, 2005). Nevertheless, for sustainability, in the case of integrated interchange points, the provision and maintenance of facilities are recommended to be handed over to the consortiums using the interchange points. For the provision of elevators/conveyors, DisHub or BP TransJakarta should invite private sectors through advertisement as applied in one of the first corridor's BRT interchange.
1.1.	Not protected from rain	The sides of overpass are protected with transparent safe material	□Financial	
1.2.	Long climbing and long walking	Complement the ramps/stairs with elevators or conveyors	□Security: prevention of the facilities being stolen	
2	**The design of waiting amenity**			
2.1.	Long , ineffective, and dangerous queue	**Basic Level** Provide more space for queuing to accommodate peak-hour passengers through building multiple stopping bays at one integrated interchange point	Readjustment of the next interchange spacing	
			Financing	
2.2.	The interchange is small	**Level-1** Provide amenities: air-conditioner, seating furniture, trash can, restroom, and public phone	Financing of provision and maintenance	
2.3.	Minimalist designed seating furniture and trash can are available			
2.4.	Air-conditioner is available at some interchanges			
2.5.	Restroom are not available inside the interchange			
2.6.	Public phone is available at some main terminals			
2.7.	Kiosk is available only at main terminals but not inside the BRT interchange	**Level-2**		
		Waiting activities inside and outside the interchange		
		□ Waiting activities inside interchange: kiosks, newspaper stands	Financing	DisHub or BP TransJakarta can invite private sector to participate through advertisement, kiosks/newspaper stands supply.
			Land availability	Underground level
		□ Good access to surrounding commercial and public facilities	Partnership with private sector	PPP scheme should be developed.
3	**Parking facilities at HCB and SWPA for taxi and paratransit**			

CURRENT STATUS		EXPECTED LEVEL OF INTERMODALITY	FIRST STAGE BARRIERS	RECOMMENDATION
3.1.	Informally available	**Basic Level** Integrate the parking facilities with BRT interchange	Paratransit is considered illegal: government mind-set versus public acceptance	Change government mindset and create modern image of paratransit to be integrated with BRT system
			Land availability	Cooperate with nearby private buildings to provide parking space for paratransit
4	**Parking facilities at main terminals**	**Basic Level**		
	Park-and-ride	Located 5 - 10 minutes walk from the interchange	Land availability	Apply efficient parking arrangement if necessary, for example, multi-story parking lots as applies in Tokyo, Japan
		Well planned capacity	Planning expertise	In order to pursue significant modal shift, it is better to use public money for carrying out thorough planning, providing the proper technology, and establishing attractive fare structure.
		Attractive parking fare	Subsidy required	
		Guaranteed security	Technology and financing	
FINWARE		**Basic Level**		
5.1.	Some interchanges still use paper-based ticket	Enhance and standardize all corridors' fare payment media	Merge or coordinate three ticketing companies in charge for three phase of BRT development	Establish single clearing center (limited company) to: (i) integrate and operate fare payment media; and (ii) manage the revenue collection and distribution
5.2.	Tickets are sold at two ticket booths manually which create queues during peak hour	Complement with automated ticket vending machine at interchange points	Technology, expertise, and financial	
5.3.	Current coordinated fare structure with large bus services (feeders): not fully accepted by bus crews	Well-coordinated fare structure with all types of bus services	Patronage-based revenue sharing system management run by conventional buses	Reform the provision and management regime of existing bus system by introducing competitive regime
			Ensuring each participant does not loss revenue	
		Standardized fare media	Acceptance from existing bus operators and crews	
SOFTWARE		**Basic Level**		
6.1.	No route maps highlighting interchange opportunities available either at BRT interchange, bus shelters, or train stations	Route maps highlighting interchange opportunities available either at BRT interchange, bus shelters, or train stations	No accurate existing bus routes data are available	Organize and update current operating bus routes
			Large bus routes overlapping more than 50% with 15 corridors are still under restructuring	Accelerate bus routes restructuring comprehensively
6.2.	Temporary signage and only available inside the BRT interchange	Clear signage and routeway from bus shelters or train stations along way to the ramps until the interchange	Incremental development of BRT corridors and bus routes restructuring	

CURRENT STATUS		EXPECTED LEVEL OF INTERMODALITY	FIRST STAGE BARRIERS	RECOMMENDATION
6.3.	No timetable available	Timetable of BRT service available at BRT interchange	Addressing vehicle insufficiency, intersection delay, and other bottlenecks	Enforcement to operators to fulfill vehicle requirements Minimizing mixed traffic Optimizing the location of interchange (spacing and relative distance from intersection) Set up timetable by emphasizing on minimizing passengers waiting time

Further questions are (i) who should and how to organize the improvement of intermodality as recommended and lobby private sectors to participate; and (iii) how to accelerate current bus routes restructuring which are particularly essential to realize software and finware integration. Currently, all the planning and financing are within the hand of DisHub, while BP TransJakarta is only responsible in managing the BRT system. Further, particularly for providing sufficient pedestrian ways and in the future bikeways and bus-based TOD, good coordination among multi-agency is required. As applied by other countries, intermodality required fully independent bodies with relevant capacity. Thus, Jakarta will need three separate functions:

- Transport authority for establishing and controlling strategic policies with sufficient legal power;
- Transport planning company in tactical level to plan and set the design and conduct competitive tendering to realize the pre-determined design including timetable and providing integrated information system; and
- A single clearing centre operation of ticketing and revenue collection system.

CONCLUSION

TransJakarta's system is operating insufficiently. The lack of intermodality measures implementation would likely jeopardise the effectiveness of the entire system, particularly in improving the system accessibility and the uncertainty risk of travel time caused by long transfer and waiting time. Therefore, it is recommended to upgrade TransJakarta's level of intermodality at least by emphasizing on reducing physical effort carried out by passengers to interchange, providing necessary parking facilities, minimize transfer and waiting time through finware and software improvement measures. To realize the expected level of interchange design, the barriers identified are mainly land availability, financial, technology and expertise. While software and finware lead to more essential institutional barriers for establishing more effective decision making process, management process, and primarily for accelerating public transport reform.

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