Recent Transition in Transportation Environment in Jakarta Metropolitan Area Over Years

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Abstract: The Jakarta metropolitan area of Indonesia with more than 24 million populations is the capital region of one of the emerging countries. Along with economic development, the number of motorized trips, especially, use of motorcycles has been rapidly increasing. Two surveys that were conducted in 2002 and 2010, Household Travel Survey (HTS) and Commuter Travel Survey (CTS), revealed significant alteration in, for example, transportation pattern, income, mode share, mode choice, and so on in Jakarta metropolitan area. Number of population as well as number of registered vehicle is increasing. Existence of BRT also indicated changes in mode choice before and after the introduction of the BRT system in 2004. The characteristics of these preferences were also identified.

Keywords: Jakarta, economic development, transition, BRT, mode choice.

1. Introduction

The city of Jakarta is the capital of the Republic of Indonesia and the largest city in the country. Jakarta city and the surrounding 8 municipalities comprise Jakarta metropolitan area with approximately 24 million populations according to the 2005 intermediate population census. The gross regional domestic product (GRDP) of the Jakarta reached Rp.617 trillion (Indonesian rupiahs) (approx. 65 billion US dollars) in 2005, which is approximately 22 percent of the total Indonesian gross domestic product (GDP); thus, it is economically the most important area of the country. Although there are large gaps between districts, the GRDP per capita of a district in Jakarta has reached the level of developed countries. Along with economic development, the number of motorized trips, especially, use of motorcycles has been rapidly increasing. For instance, the number of registered motorcycles increased almost three times in this decade. This aggravated urban transportation problems, such as traffic congestion, and they are worsening in the Jakarta metropolitan area. It is feared that this will hinder economic development

by suffocating the flow of people and goods. Distribution capabilities have suffered because of longer travel times, and environmental decline caused by air pollution, due partly to vehicle exhaust, has become a social issue [1].

In this regard, Jakarta city is planning to provide new transport modes such as BRT (bus rapid transit), MRT (mass rapid transit), and monorail. In fact, operation of the first BRT line commenced in January, 2004, and the government of the city Jakarta gradually expanded the BRT network, and twelve routes were in operation as of January 2013. Furthermore, an additional three routes are planned to be operating by the end of 2014. With the steady progress of BRT lines and other plans, the Jakarta city government is discussing to adopt a road pricing policy to restrict the car traffic volume in the CBD because simple improvement of public transport may not be enough to induce the car users to shift to public transport [2].

It is anticipated that there are many large cities in rapidly growing developing countries facing similar transportation problems. As mentioned in the Jakarta metropolitan transportation master plan [3-5], how to

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shift private mode to public mode of transport is considered as a common concern for those cities.

As such, this paper presents the creases in transportation in Jakarta metropolitan area as well as the analysis explaining them by utilizing a Household Travel Survey in 2002 and Commuter Travel Survey in 2010.

2. Surveys

2.1 Household Travel Survey (HTS)

HTS in 2002 covered the Jakarta metropolitan Area with a targeted sampling rate of 3%, which led to the sample size of some 166,600 households as shown in Table 1. Average household size is different in the city Jakarta and Bodetabek (suburban municipalities); hence, numbers of samples were calculated respectively. A random sampling method was adopted for HTS sampling rather than a stratified sampling method. The survey method was a home interview followed by a questionnaire. Interviewers were visiting homes for initial interview, leaving questionnaires, and collecting them by a re-visit usually one week later. The questionnaires include household, household member, and travel information as explained below.

Form 1: Household Information:

This survey component covers the socio-economic background of the household including residential address, telephone availability, auto/motorcycle ownership, income level, length of residency,

household composition, opinions on transport issues, and related items.

Form 2: Household Member Information:

This survey component provides information on the socio-demographic background of the household members including age, gender, occupation, work/school address, industry, workplace type, working field, monthly income, vehicle availability, transport cost, transport cost subsidy from company, and related items.

Form 3: Travel Information:

This survey component covers the characteristics of the trips made by the household members on a weekday (Tuesday, Wednesday, or Thursday) including origin and destination, travel purpose, transport mode, transfer, departure and arrival times, and related items.

2.2 Commuter Travel Survey (CTS)

CTS in 2010 also covered the Jakarta metropolitan area with a targeted sampling rate of 3%, which led to the sample size of some 179,000 households as shown in Table 1. A random sampling method was also adopted for CTS sampling. The survey method was also a home interview followed by a questionnaire; however, interviewers were visiting homes for interview only once. Survey form consisted of socioeconomic conditions of household and household members (similar to the above-mentioned Forms 1 and 2), polling of opinion, and detailed information (similar to the above-mentioned Form 3) of work or school trips made by household members who regularly go to work

Table 1 Sample Size of HTS and CTS.

Source: Yagi, S. et.al. (2013)

a) HTS (2002)

	DKI Jakarta[1]	Bodetabek[2]	Total
Population[3]	8,447,000	13,127,000	21,574,000
No. of households	2,253,700	3,300,800	5,554,500
Average household size[4]	3.75	3.98	3.88
No. of HTS zones (villages)	261	1,224	1,485
No. of sampled households[5]	67,600	99,000	166,600

Notes: 1/ Capital District

2/ Suburban Municipalities

3/ Estimated based on census (as of 2002)

4/ Based on population census

5/ Calculated at a sampling rate of 3%.

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b) CTS (2010)

	DKI Jakarta[1]	Bodetabek[2]	Total
Population[3]	10,225,000	17,686,000	27,911,000
No. of households	2,353,000	4,953,000	7,306,000
Average household size[4]	4.35	3.57	3.82
No. of HTS zones (villages)	386	1,273	1,659
No. of sampled households	50,200	128,800	179,000

Notes: 1/ Capital District

2/ Suburban Municipalities

3/ Estimated based on census (as of 2010)

4/ Based on population census

or school. The above-mentioned income-related bias was also revealed in the CTS dataset, and hence the weight factors have also been adjusted so that it would reflect the current regional vehicle registration data.

In JUTPI, the analysis results obtained from the CTS dataset were first compared with those from the previous HTS dataset. That is, distributions of household socio-demographic attributes as well as travel characteristics (e.g., trip rates) were compared to analyze the change in the society as well as the transportation environment in the Jakarta metropolitan area.

3. Comparison Results

3.1 Demographic Features of Jakarta Metropolitan Area

The population of the Jakarta metropolitan area has 10% of population of the nation. The population of the region has increased 1.6 times in 20 years; from 17 million in 1990 to 28 million in 2010 as shown in Figure 1 below.

The region is the growth center with a share of roughly 30% of gross domestic products (GDP) and roughly 40% of investment from abroad. While the transportation in the Jakarta metropolitan area heavily relies on road transportation (almost 98%), the surge in the number of motorized vehicle is tremendous. This is worsening the congestion in the region and is causing huge economic loss. In Figure 2 we can see the number of registered motorcycles increased almost three times in this decade.

The gross regional domestic product (GRDP) of Jakarta metropolitan area reached Rp.617 trillion (Indonesian rupiahs) (approx. 65 billion US dollars) in 2005, which is approximately 22 percent of the total Indonesian gross domestic product (GDP); thus, it is economically the most important area of the country. Although there are large gaps between districts, the GRDP per capita of a district in Jakarta has reached the level of developed countries.

Based on the strong economic growth, the number of low income households has been reducing. The share of middle income households, those with a monthly household income of more than 1.5 million Rupiah and less than 6 million Rupiah, has been growing rapidly and is now more than 50% (see Figure 3).

A total of 743 thousand trips per day in 2002 were made by residents from outside the city Jakarta going inside the city. Increasing 1.5 times, a total of 1.105 million of the same trip were made per day in 2010. As shown in Figure 4, 1.4 times increase of the trip happened from westbound and southbound of the city of Jakarta, and 1.6 times increase of the trip happened from eastbound of the city.

3.2 Vehicle Ownership and Mode Share

In 2002, out of 5.7 million households, 977.6 thousand households or 17.2% own car(s). The number of households with more than one car is 155.1 thousand households, accounting for 2.7%. On the other hand, 1.9 million households or 34% own motorcycle out of 5.7 million households. The number of households with

more than one motorcycle is 170 thousand households, accounting for 3%.

In 2010, out of 7.31 million households, 1.80 million households or 24.7% own car(s). The number of households with more than one car is 238.2 thousand households, accounting for 3.3%. On the other hand, 5.25 million households or 71.9% own motorcycle out of 7.31 million households. The number of households with more than one motorcycle is 1.58 million households, accounting for 21.5%.
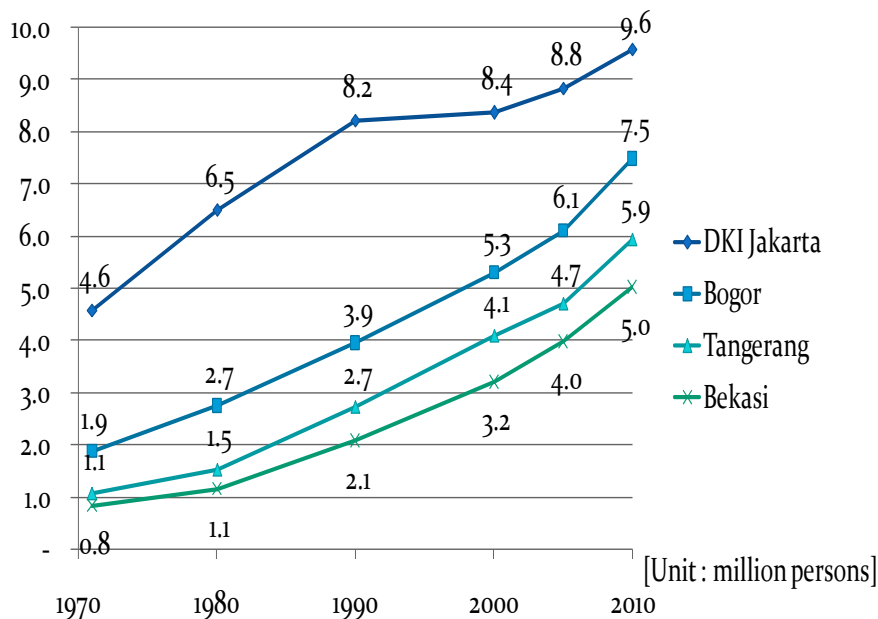
Fig. 1   Population of Jakarta Metropolitan Area.
Source: Statistical Year Book of Indonesia 1998, Population Census 2000, Population Census Intermediate Survey 2005, and Population Census Preliminary Figure.
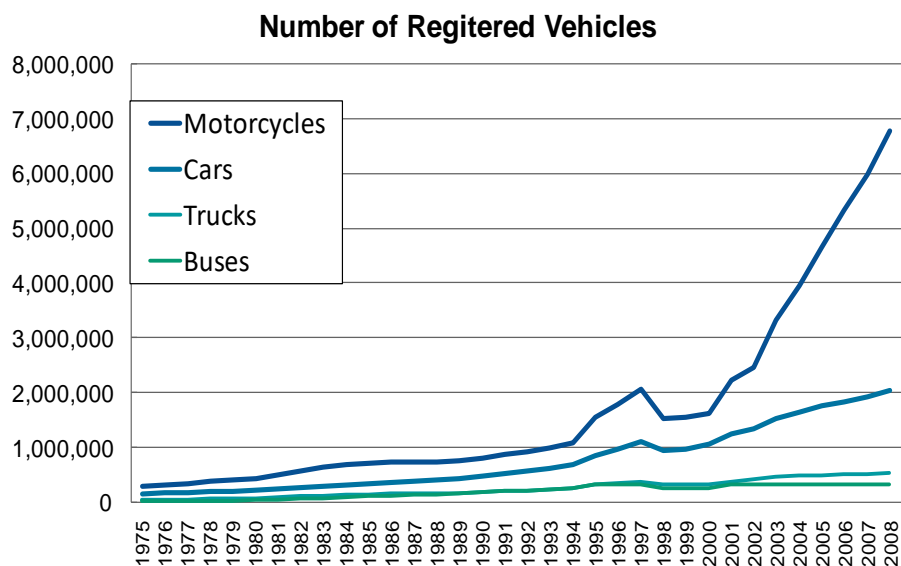
Fig. 2   Increase in Number of Registered Vehicle.
Source: Polda Metro Jaya (Regional Police)

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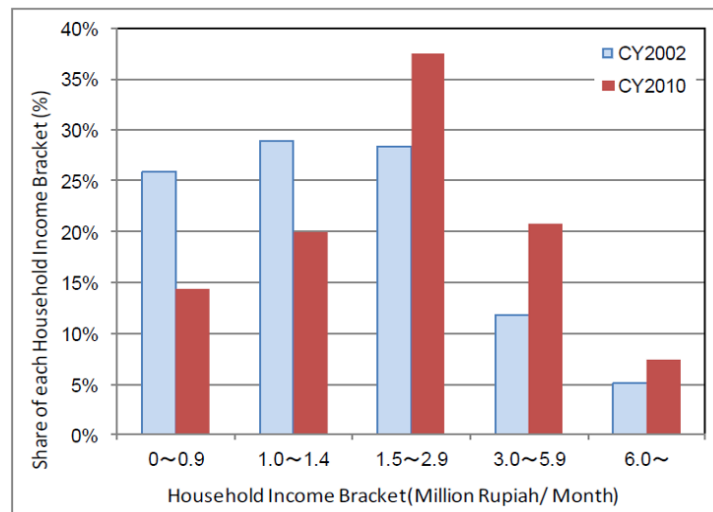
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Fig. 3   Income Distribution Comparison of 2002 and 2010.
Source: STRAMP Person Trip Survey, JUTPI Commuter Survey
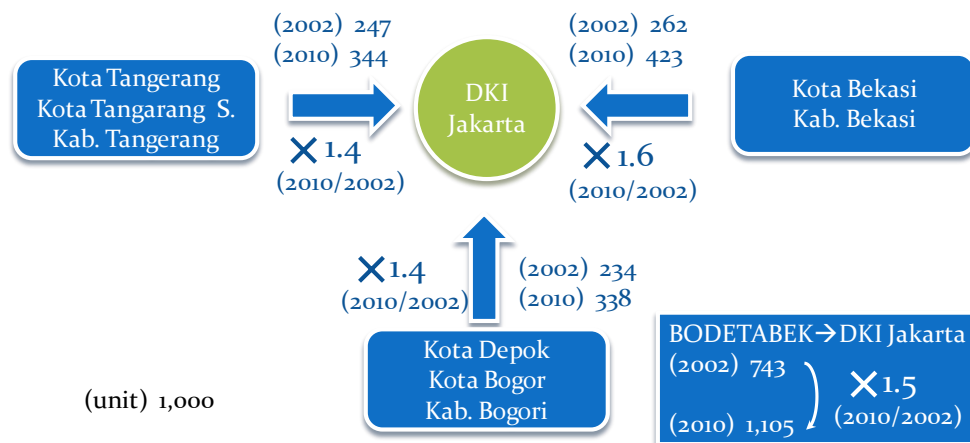

Fig. 4   Commuters to the city of Jakarta of 2002 and 2010.
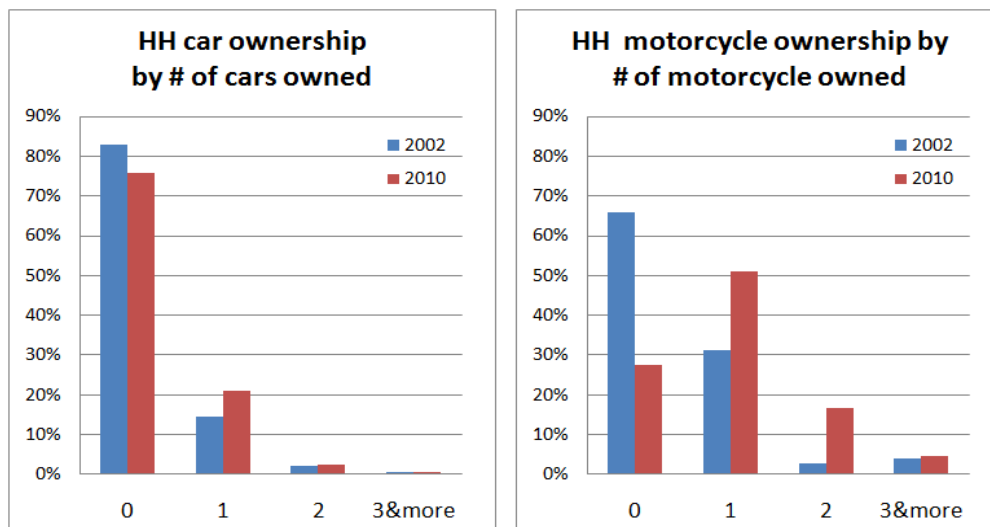Source: Preliminary Figures of JUTPI Commuter Survey

Fig. 5   Car and Motorcycle Comparison of 2002 and 2010.
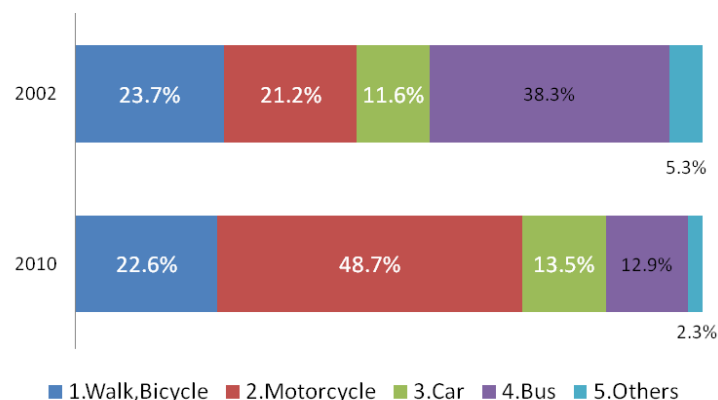Source: Preliminary Figures of JUTPI Commuter Survey

Fig. 6   Change of Mode Share of To Work Place Trips: 2002 and 2010
Source: Preliminary Figures of JUTPI Commuter Survey

Mode share varies according to trip purpose. Regarding mode share of "to work" trips, Figure 6 shows interesting findings that can be found in the mode share of private transport that is composed of private car and motorcycle. In 2002, the mode share of private transport is lower than public transport. Increase of 29.4% of private transport mode shares happened in 2010 where the mode share of private transport is higher than public transport. Meanwhile, the mode share of non-motorized transport and bus in 2010 is lower than in 2002.

3.3 Mode Choice Before and After the Bus Rapid Transit (BRT) Development

The city of Jakarta is keen to develop a BRT system with a dedicated lane and stations called "Transjakarta". Transjakarta started their operation in 2004 and 8 corridors, with a total length of 97 km, were carrying 200,000 daily passengers in the city of Jakarta at that time. The city government has developed additional four corridors by the end of 2012 (corridors 9, 10, 11, and 12). Furthermore, additional three corridors 13, 14, and 15 are being planned (now in detail design process) to be operated within 2014.

Since it is expected that there have been significant changes in mode choice behaviour in this last half decade, transition in mode choice behaviour was analyzed. Transportation mode choice before the implementation of the BRT system and commuting/residential place

before the implementation of BRT were also investigated in the interviews of Commuter Travel Survey (CTS). Through these questions, the mode choice data become almost equivalent to panel survey data. Comparison of the mode choice before the BRT system and current choice is in Figure 8 below. The analysis was focused on respondents whose address was the same before and after the implementation of the BRT system. For commuting purpose analysis, only the respondents whose workplace and school was same were utilized for comparison.

For non-commuting trips, a hypothetical destination was set by the interviewer randomly and the mode choice before and after the BRT system was analyzed.

It is noteworthy that the share of private vehicles has remained almost the same in this five year period for commuting trips while BRT system was installed to the surveyed locations and yet a significant increase in the number of motorcycles is observed in the city. Instead, the share of other public transport (mainly buses) decreased and was replaced by the new BRT system. In terms of commuting purpose, the city's intention of modal shift by installation of the new BRT system was not achieved for the surveyed corridors.

For non-commuting trips, the behaviour is unique by income level (see Figure 9). The share of low income motorcycle users has increased. This may be explained by dissemination of motorcycle loans for low income
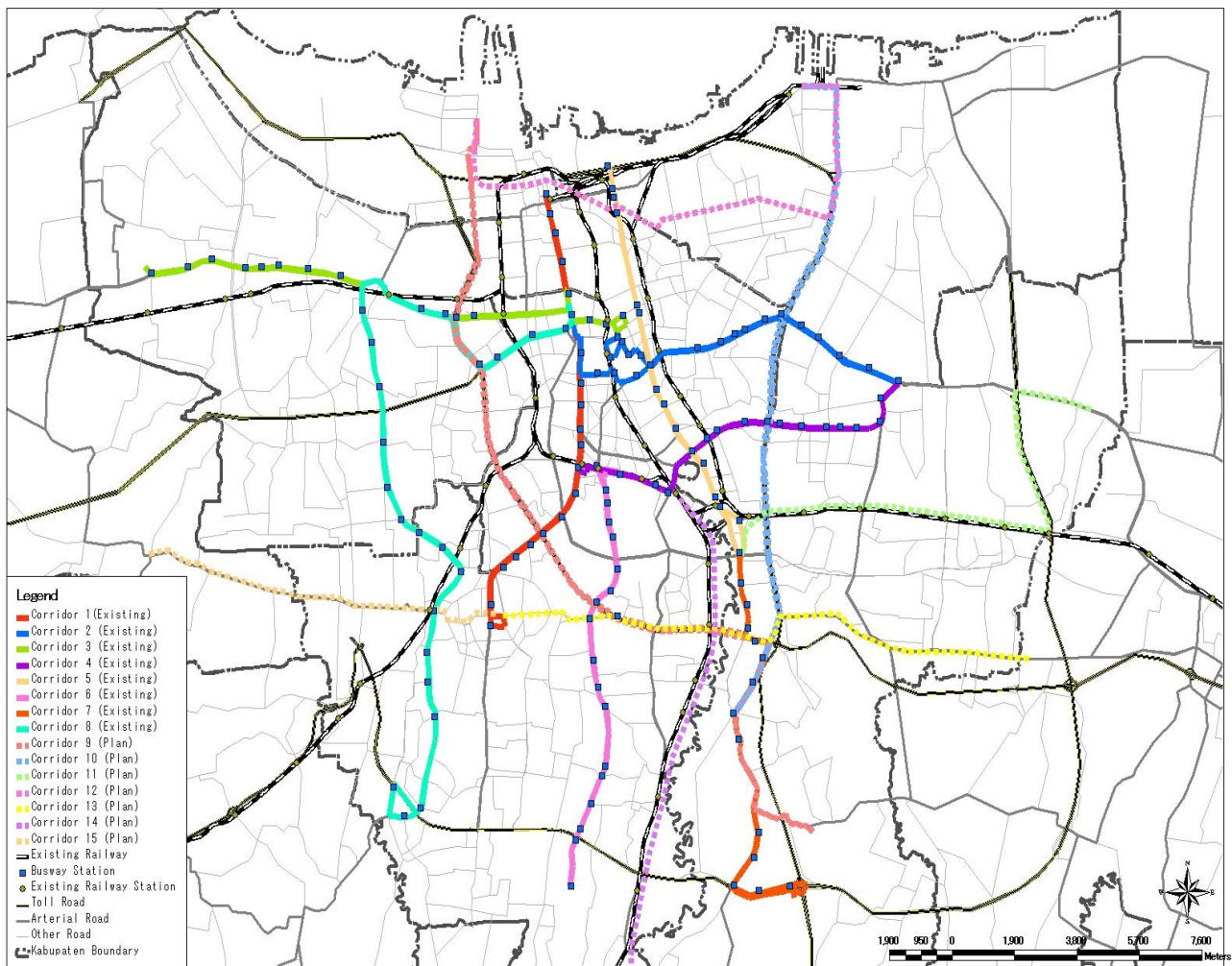
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Fig. 7   Existing and Plan BRT Network in the city of Jakarta (map year: 2004).
Source: Kawaguchi, Hirohisa et.all, Transition in Mode Choice due to Motorization and Improvement of Public Transportation System in Jakarta, 12th WCTR, July 11-15, 2010 – Lisbon, Portugal
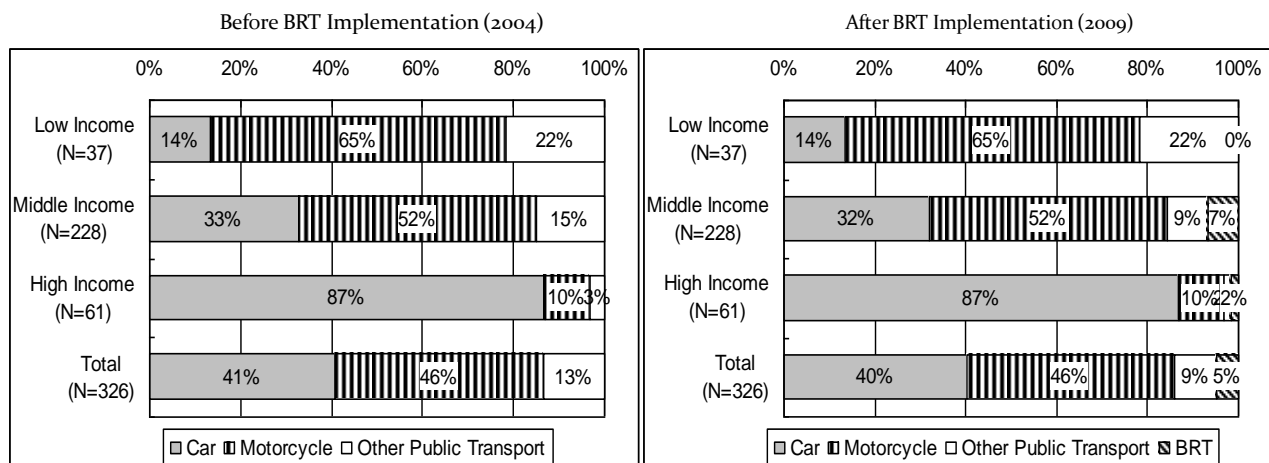

Fig. 8   Mode Choice (Commuting Trips) Before and After BRT.
Source: Kawaguchi, Hirohisa et.all, Transition in Mode Choice due to Motorization and Improvement of Public Transportation System in Jakarta, 12th WCTR, July 11-15, 2010 – Lisbon, Portugal
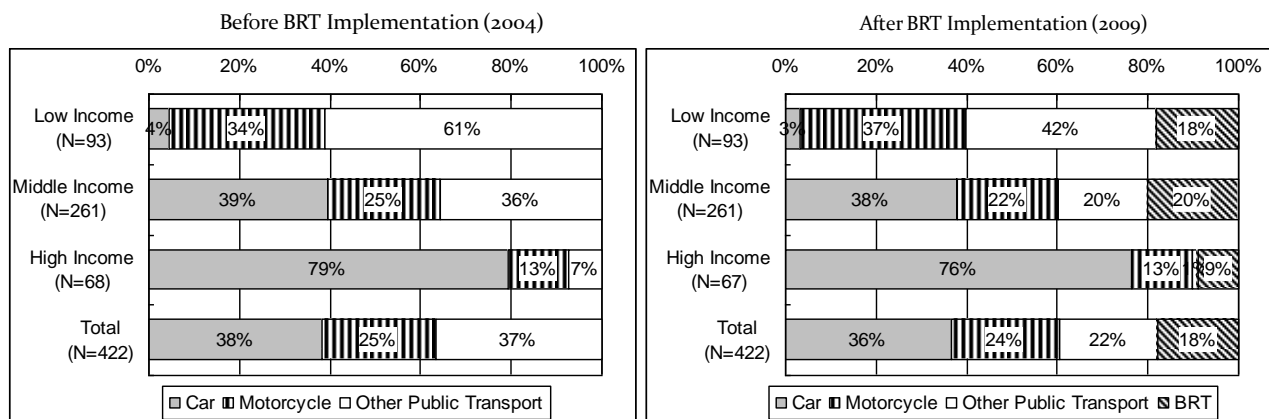
Fig. 9   Mode Choice (Non-Commuting Trips) Before and After BRT.

Source: Kawaguchi, Hirohisa et.all, Transition in Mode Choice due to Motorization and Improvement of Public Transportation System in Jakarta, 12th WCTR, July 11-15, 2010 – Lisbon, Portugal
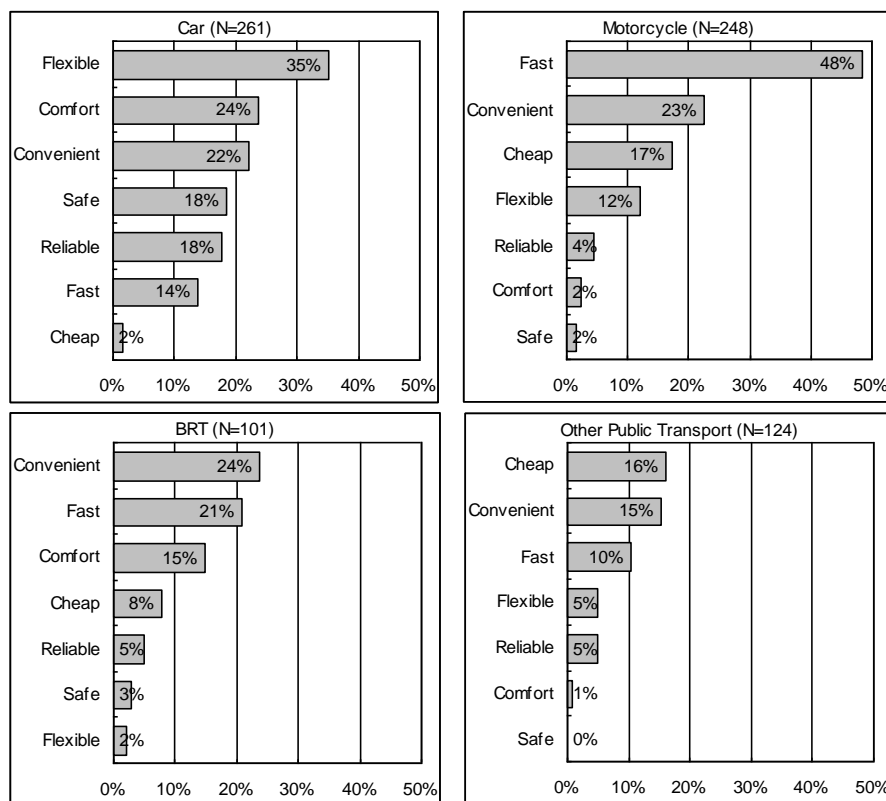

Fig. 9   Reasons for Current Mode Choice.

Source: Kawaguchi, Hirohisa et.al. (2010)

groups and the current surge in motorcycle ownership. On the other hand, the share of public transport (BRT and other public transport) has increased for respondents with high and middle household incomes. For the middle income group, the use of public transport increased to equal roughly 4% of all modes. Travel speed of the BRT system in peak hours is not always

competitive due to congestion at intersections where dedicated lanes for the BRT system have not been completed. This might affect the mode choice of commuting trips.

Against the assumption of the surge in motorcycle use, the share of motorcycles was not increased or rather decreased as a whole except for low income non-

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commuting trips. Since the survey was targeted at BRT corridors where public transportation service level has improved, it is assumed that the surge in motorcycle use may be observed in the areas beyond BRT corridors. The increase in trip rate due to motorcycle use may also explain the growing number of motorcycles in traffic count surveys.

The reasons for choosing the current mode of transport were also investigated during the interviews. The choice set for the questions was prepared considering similar survey results and opinions of local residents. The question was multiple choice style and the top 7 reasons by transportation mode are shown below. The results well described characteristics of the traffic condition in the Jakarta metropolitan area. Car users prefer flexibility and comfort rather than time and price. In the Jakarta metropolitan area, travel time of cars and buses are quite difficult to project due to sever congestion. Since the motorcycle is a virtually "congestion-free" mode of transport by running through the narrow space between cars, it is quite evident that the majority of motorcycle users prefer a faster mode. They also evaluate its convenience as high.

4. Conclusion

The same as other metropolitan areas in developing countries, development of transportation and other infrastructure in the Jakarta metropolitan area cannot catch up with the speed of her growing population and economy while the city government is also tackling the problem by providing the new BRT system. In addition, the surge in motorcycle ownership made it difficult for the city to shift public mode of transport. This paper focused on the transition in mode choice and provides a descriptive analysis as well as development of mode choice model utilizing a stated preference survey.

It is noteworthy that the passengers who shifted to the BRT system were previous users of other public modes of transport while the transition from private motorized transport is limited. In terms of reasons for mode choice, the results showed that car users chose it

due to flexibility and comfort while motorcycle users find reasons in travel time and convenience. Thus, it is said that BRT have attracted previous users of other public transportation by its convenience and shorter travel time.

Finally, since development of transport infrastructure and speed of motorization is more rapid in developing countries, it might be reasonable to incorporate variables on current or previous mode choice history. Overall, it is expected that this experience in the Jakarta metropolitan area will give insight on transition of mode choice behaviour in other cities in developing countries.

Acknowledgment

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