Mode Shift Travel Demand Management Evaluation
From Jakarta’s Experience

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Abstract:
The study is meant to simply evaluate the mode shift TDM operational strategies from selected alternatives, available for metropolitan cities in Indonesia. Jakarta would be selected as sample city, while it has been producing more than 20 million trips every day, concentrating at very small area of 20 km2 out of 656 km2. Development of Busway, School Buses, Jakarta Staggered Working Hours and Road Pricing schemes would be elaborated, comparing with the current vehicle occupancy “3 in 1” policy. Selection of strategies would including transportation, financing and environmental aspects.

Key words: TDM, mode shift, congestion.

1. BACKGROUND

The influences of motorization and urbanization in Indonesia, later followed by sub-urbanization in many metropolitan areas, have been of interest to transportation and urban researchers for the last few decades (Bappenas-JICA, 2004, Tamin, 2006, Prayudyanto, 2007, Soehodho, 2007, Susilo, 2007). However, most of the studies were based on evidence in developed countries. It is unclear whether the results were also valid in developing countries, since the transportation conditions of both situations are different in many fundamental ways. Sprawling urban growth with a poor public transport network has also supported the trend of motorization among urban residents in developing countries cities in Indonesia, such in Jakarta, Surabaya, Medan, Makassar and Bandung.

Jakarta Special Province has economically expanded beyond its original fringes and has been integrated with four other proximate cities, namely Tangerang (in the west), Bekasi (in the east), Bogor, and Depok (in the south). The metropolitan area has been called “Jabodetabek” since 1999 (in this paper, we refer to it as the Jakarta Metropolitan Area, JMA). The JMA area encompasses a total land area of 6,580 square kilometers, which has a flat configuration with an average elevation of only 5 meters above sea level. The core area of JMA (Jakarta city) itself covered 656 square kilometers and comprised 8.4 million people in 2000. The 5,924 square kilometers beyond Jakarta has an aggregate population of 13.1 million. The JMA accounts for 10% of Indonesia’s population and 20% of its GDP. Surabaya has also economically expended with other proximate cities called Gerbang Kartosusilo (Gresik, Bangkalan, Mojokerto, Surabaya, Sidoarjo and Lamongan). Medan has such area called Mebidang (Medan, Binjai and Deli Serdang). Other cities having sprawling effect are Bandung, Semarang, Makassar and Surakarta.

Traffic composition in Jakarta and Metropolitan Cities is dominated by private cars, but other type of cities likely “motor cycles cities”, a city which dominate (more than 60%) by
motor cycles. UTPP (1999) reported that 50.8% of traffic composed by private cars, but in large (city with population between 500,000 to 1 million), medium (100,000-499,000 inhabitants) and small cities (less than 100,000 inhabitants), more than 50% of traffic by motor cycles (Table 1). In most of the cities in Indonesia, low capacity of public transport is mainly caused by the dominant of small size urban public transport of 8-12 passenger capacity. In total, it is only 15 cities out of 400 cities throughout Indonesia operates medium and big of buses. The dominant of motor cycle has been recorded since 1999 by Bappenas (UTPP, 1999) and Bappenas-JICA (Sitramp, 2004). Rather having mode shift from private car to public transport, road users likely to shift to motor cycles due to practicality, accessibility and cheap.

<table>
<thead>
<tr>
<th>Mode</th>
<th>DKI Jakarta</th>
<th>Metropolitan Cities</th>
<th>Large Cities</th>
<th>Medium Cities</th>
<th>Small Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Transport</td>
<td>10.6 %</td>
<td>11.0 %</td>
<td>7.0 %</td>
<td>8.0 %</td>
<td>11.0 %</td>
</tr>
<tr>
<td>Freight Transport</td>
<td>6.6 %</td>
<td>6.6 %</td>
<td>11.0 %</td>
<td>15.0 %</td>
<td>18.0 %</td>
</tr>
<tr>
<td>Private Cars</td>
<td>50.8 %</td>
<td>50.8 %</td>
<td>32.0 %</td>
<td>22.8 %</td>
<td>19.0 %</td>
</tr>
<tr>
<td>Motor Cycles</td>
<td>32.0 %</td>
<td>31.9 %</td>
<td>50.0 %</td>
<td>54.6 %</td>
<td>52.0 %</td>
</tr>
</tbody>
</table>

Source: UTPP, 1999

Traffic congestion in Jakarta and metropolitan cities is serious and impacting the many facets of urban life. From 1985 to 2000, Jakarta average trip length for work, school, and shopping increased 43%, 104%, and 85% respectively. Trips for work purposes increased from 6.7 km in 1985 to 9.6 km in 2000, while the length for school trips also increased from 2.7 km to 5.5 km. The increase of trip length is caused by the urban sprawling effect, which makes people lived further away. Related to household income, a higher income group is associated with longer average trip length and a higher number of daily trips. For private car trips, from 1985 to 2000, the number of trips by private car increased by 32%. The occupancy rate decreased from 1.96 to 1.75, which shows that in 2000, people tended to make more solo trips than in 1985. This shows that congestion is also worsening the global environment and degrades the quality of urban life by making travel unreliable.

Supplying the better roads to relief the congestion problem could not always be the best option because building the better roads may induce more traffic. Thus, the demands should be restricted to match the supply. Since a few decades ago, sustainable transport has been introduced in some congested cities and it has been widely suggested like an appropriate policy tool for reducing traffic congestion problem.

2. ESTIMATION OF FUTURE TRANSPORT PERFORMANCE

Schipper and Fulton (2002) argued that to develop sensible, sustainable plans and policies in transport by concept of sustainable transport, it is first necessary to understand where one stands and where one is heading.

From 1985 to 2002, Jakarta car ownership increased approximately three times and motorcycle ownership three and a half times. The average number of cars owned per 100
households is 20.7 and the average number of cars owned per car-owning household is 1.2, which is relatively the same with or even higher than developed countries (Bappenas-JICA in Susilo, 2007).

![Figure 1. Jakarta Metropolitan Area (JMA) Network](image)

Of all the person trips made by motorized modes, buses made up more than 50 percent. Even though the number of buses has decreased due to the economic crisis, the bus is still the most significant mode of transport used by the majority of citizens in the region. Private cars are used by 31 percent of people and a motorcycle by 14 percent of people. Grouping the mode choices based on income level shows very clear evidence that in Indonesia private cars are mostly used by higher income groups (Bappenas-JICA, 2004). As traffic in Jakarta City Center has been getting congested, the total number of commuters from surrounding cities to Jakarta is estimated to increase from 762 thousand persons per day in 2000 to about 1.8 million in 2015 (Bappenas-JICA, 2004).

This uncontrolled motorization in the JMA has significantly affected the quality of urban resident’s lives in all aspects, not only in economic and travel aspects but also in social, psychological, and health aspects.

In forecasting the likely future traffic condition in Jakarta and JMA, the validation of current traffic data should be based into account. Comparing 2000 and 2007 (Table 2) data shows very much different traffic characteristic (JETRO, 2008):
Increasing motor cycle. The growth of motor cycles during last 7 years reaches 238%, or at least 30% per annum. As seen in Table 2, the number of cars in 2007 at some road sections is only 0.94 than those in 2000, but motor cycles reaches 2.38.

Travel speed decreases, by having 77% during last 7 years, meaning that car trips are in many congested locations than 2000.

### Table 2 Traffic Flow Comparison

<table>
<thead>
<tr>
<th>Road Section</th>
<th>Traffic Volumes (16 hrs counts)</th>
<th>Avg. Speed (km/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jl. HR Rasuna Said</td>
<td>121,057</td>
<td>41,669</td>
</tr>
<tr>
<td>Jl. Sudirman</td>
<td>154,987</td>
<td>38,445</td>
</tr>
<tr>
<td>Jl. Hidup Baru</td>
<td>10,829</td>
<td>8,664</td>
</tr>
<tr>
<td>Jl. Industri</td>
<td>32,966</td>
<td>21,401</td>
</tr>
<tr>
<td>Jl. Angkasa</td>
<td>62,031</td>
<td>42,634</td>
</tr>
<tr>
<td>Jl. Kepu Selatan</td>
<td>11,719</td>
<td>9,498</td>
</tr>
<tr>
<td>Jl. Letjen Suprapto</td>
<td>65,366</td>
<td>37,203</td>
</tr>
<tr>
<td>Jl. Pramuka</td>
<td>76,684</td>
<td>38,921</td>
</tr>
<tr>
<td>Jl. Tomang Raya</td>
<td>58,996</td>
<td>29,117</td>
</tr>
<tr>
<td>Jl. Kiyai Tapa</td>
<td>62,755</td>
<td>30,822</td>
</tr>
<tr>
<td>Jl. Tubagus Angke</td>
<td>35,363</td>
<td>28,672</td>
</tr>
<tr>
<td>Jl. Bandengan Selatan</td>
<td>47,379</td>
<td>33,895</td>
</tr>
<tr>
<td>Total/Average</td>
<td>740,132</td>
<td>393,342</td>
</tr>
</tbody>
</table>

As can we seen in Figure 2, the range of traffic volume growth in 12 sections, motor cycles growth as 2-3 times than cars. A small interviews with those who have both types of cars, depicts the facts that the travel costs of motor cycles (1 liter for 20-30 kms) is far under those of private cars (1 liter for 10 kms), while travel speed of motor cycles is faster than cars, at congested roads.

![Motor Cycle and Car Growth by Link](image)

This growth of vehicles had also been followed by number of fatalities in traffic accidents. It has also been reported in many studies that suspecting no significant traffic improvement in five to ten years to come such fatalities would have been growing and multiplying (Soehodho, 2007).
3. DEVELOPING SUSTAINABLE TDM

In developing assessment of traffic strategies improvement for developing countries, the concept of Sustainable Transport has been adopted. European Federation for Transport and Environment explains the idea of sustainable transportation to provide a framework to balance the ecological, social and economic challenges. Banister (2005) argued that the challenge for sustainable urban development is the requirement of clear and substantial action, either to accommodate the scale of expected growth or to explore the means by which economic growth is not limited by substantial increases in energy and transport consumption.

Four major TDM policies, i.e. Time Shift, Route Shift, Mode Shift and Location Shift, are proposed by Tamin (2000) and Fergusson (2002) in Prayudyanto (2007) as shown in Table 2.

<table>
<thead>
<tr>
<th>POLICY</th>
<th>STRATEGY</th>
<th>OPERATIONAL TECHNIQUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME SHIFT</td>
<td>Alternative Hours</td>
<td>• Staggered Working Hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Flexible Hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Compressed Working Weeks</td>
</tr>
<tr>
<td></td>
<td>Heavy Commercial Vehicles</td>
<td>• Truck Routes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• HCV Entry/Use Restrictions (Time and Space)</td>
</tr>
<tr>
<td></td>
<td>Intelligent Transport</td>
<td>• Road Traveler Information</td>
</tr>
<tr>
<td></td>
<td>System</td>
<td>• PT User Real-Time Information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Internet Transport Information</td>
</tr>
<tr>
<td>ROUTE SHIFT</td>
<td>Economic Measures</td>
<td>• Taxation Measures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Congestion Pricing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cordon/Route Tolls</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Employer PT Subsidy</td>
</tr>
<tr>
<td></td>
<td>Alternative Modes</td>
<td>• Ride Sharing Promotion: Carpools, Vanpools</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Guaranteed Ride Home Programme</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Rideshare Matching</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Subscription Buses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shuttle Buses</td>
</tr>
<tr>
<td>MODE SHIFT</td>
<td>Vehicle Occupancy</td>
<td>• “3 in 1”</td>
</tr>
<tr>
<td></td>
<td>Public Transport Service</td>
<td>• MRT (Subway)</td>
</tr>
<tr>
<td></td>
<td>Improvement</td>
<td>• Monorail</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Busway</td>
</tr>
<tr>
<td></td>
<td>Travel Substitutes by</td>
<td>• Teaworking</td>
</tr>
<tr>
<td></td>
<td>Tellecommunications</td>
<td>• Teleconferencing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Teleshopping</td>
</tr>
<tr>
<td>LOCATION SHIFT</td>
<td>Land Use Rearrangement</td>
<td>• High Density Housing near PT Stops</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Higher Densities in New Growth Areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Local Growth Limits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mixed-Use Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Neo-Traditional Suburban Design</td>
</tr>
</tbody>
</table>

Source: Tamin (2000)
4. MODE SHIFT TDM STRATEGY FOR JAKARTA

In order to suppress the rapid motorization as well as to reduce severe traffic congestion, accidents, social and environmental impacts, several different policies have been tried in the JMA, from traffic restraint policy (i.e. high occupation vehicle policy) to land use policy. These policies are meant to “push” public transport service improvement and to “pull” car traffic restraint scheme. Five TDM strategies have been evaluated: a) Vehicle Occupancy “3 in 1”, Busway System, School Bus, Staggered Working Hours and Electronic Road Pricing.

4.1 Vehicle Occupancy “3 in 1” Strategy
The policy is commenced in the 1992 Non Aligned Summit Meeting in order to effluent the incoming/ outgoing all participants from their hotel and conventional meeting. Since its effectiveness, the policy has been promoting to serve traffic congestion during peak hours currently. Before the launching, average vehicle occupancy was 1.97, but since then, it was estimated about 3.0 to 3.5. Traffic speed has been improving, while the volume has been decreasing significantly. However, social effect has been coming up due to “jockey” to adding up number of passenger in the vehicles, by extra payment. Many car users having passengers less than 3 choose to shift their office hours lately, coming after 10.00 but lengthening their home back, from 19.00 until 21.00.

4.2 Development of Bus Priority “Busway” System
The idea of busway in improving network system, was introduced by Directorate General of Land Transportation (DGLT) Ministry of Communications (TNPR, 1992), following by busway Pre Feasibility Study in the JUTSI (1996) of DGLT. The intention of Governor Sutiyoso after his trip to Bogota, Colombia, decided to start the infrastructure and rolling stocks. The first busway corridor from Blok M to Kota commenced in 2004, serving 13.5 km with 20 bus shelter, with 60 buses and headway of 3 minutes has been improving bus and private car speed for the corridor. Currently, 7 corridors have been operated by special unit call BLU Trans Jakarta, carrying more than 210.000 passenger/day, with total revenue estimated about 235 billion rupiahs per year.

4.3 School Bus for Education Trips
After long time as second class passengers due their less fare in buses, students in Jakarta has been now served by specially design bus called a school bus. For the initial, 6 routes are operated with 35 medium sized buses with fully air conditioned. The buses are owned by local government but operated by private company. The analysis of operation and financial is presented by the consultant under Dinas Perhubungan (2007).

4.4 Staggered Working Hours Planning
Assessment of staggered working hours is conducted by private company PT. Pamintori Cipta (2007). The final recommendation is to shift office hours 30 minutes earlier. The effect seems useful, but many vicinates offices should be arranged together.

4.5 Electronic Road Pricing Planning
The assessment of Electronic Road Pricing (ERP) implementation is conducted by Dinas Perhubungan (2005), following by The Design Study (2007) and framework of legal aspect is conducted by ITDP (2007).
5. LITERATURE BACKGROUND

The impact of TDM strategy in modal shift could be formulated by many equations. **Black (1981)** in **Tamin (2000)** assumes the following equation, accommodating dual function which combine trip distribution and modal split.

\[
\frac{\hat{Q}_{id}(1)}{\sum_{m=1}^{2} \hat{Q}_{id}(m)} = \frac{1}{1 + \exp(-b(t_{id}(2) - t_{id}(1)))}
\]

(1)

\[
\hat{Q}_{id}(1) = \text{trips from zone } i \text{ to zone } d \text{ using mode 1}
\]

\[
\hat{Q}_{id}(m) = \text{trips from zone } i \text{ to zone } d \text{ using mode } m
\]

\[
t_{id}(1) = \text{impedance from zone } i \text{ to zone } d \text{ using mode 1}
\]

\[
t_{id}(2) = \text{impedance from zone } i \text{ to zone } d \text{ using mode 2}
\]

\[
b = \text{gravity model constant}
\]

A synthetical model formulates the dual mode as follows (**Tamin, 2000**):

\[
T_{id}^{kn} = A_i^n O_i^n B_d^n D_d^n \exp(-\beta_n K_{id}^n) \frac{\exp(-\lambda_k C_{id}^k)}{\sum_m \exp(-\lambda_m C_{id}^m)}
\]

(2)

Those two equations could be described using diagramatic schetche as shown in Fig.3.
VTPI (2006) recommends several parameters for evaluation of applying different TDM strategy. Prayudyanto (2007) classified these parameters into five categories as follows.

1) **Intangible Parameters:**
   a. Awareness
   b. Response
   c. Participation
   d. Utilization

2) **Transportation Parameters**
   a. Mode split
   b. Mode shift
   c. Average Vehicle Occupancy (AVO)
   d. Average Vehicle Ridership (AVR)
   e. Vehicle Trips or Peak Period Vehicle Trips
   f. Vehicle Trip Reduction
   g. Vehicle Miles of Travel (VTM) Reduced

3) **Energy Parameter**
   a. Fuel Consumption Reduction

4) **Environmental Parameter**
   a. Emission Reductions

5) **Financial Parameter**
   a. Cost Per Unit of Reduction

6. **EVALUATION OF TDM STRATEGY**

In evaluation alternative to fit the best strategy, many methods have been proposed. Tanadtang (2003) uses a multi-criteria decision making (MCDM) approach for evaluating TDM schemes by simultaneously considering transportation, environmental and social
impacts. For the evaluation of the social impacts of TDM schemes which are uncertain and incomplete due to the subjective judgments of experts, the evidential reasoning (ER) approach is adopted. Kanda, Y, et. all. (2005) proposed the effects of introducing TDM measures by evaluated focused on the delayed travel time and length of traffic congestion queue for commuter travelers. Yedla (2003) uses Multi Criteria Approach using Analytical Hierarchy Approach (AHP).

6.1 Existing Condition - Do Nothing
The current transport policy to restraint private vehicle having occupancy less than 3 (”3 in 1”) would be used as basic traffic condition, called as Do Nothing Situation. To value the Do Nothing, performance of traffic is compared between the situation with and without “3 in 1”. Table 4 resumes the performance of travel distance, travel time and travel speed for Do Nothing.

<table>
<thead>
<tr>
<th>No.</th>
<th>Road Direction</th>
<th>Before &quot;3 in 1&quot;</th>
<th>During &quot;3 in 1&quot;</th>
<th>After &quot;3 in 1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Dist. (km)</td>
<td>Time (min)</td>
<td>Speed (km/hr)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 Comparison of Traffic Performance “With” and “Without” 3 in 1

The traffic volume distribution per hour for 24 hours period in the main road Jl. Sudirman is recorded based on the type of trip purposes. Most of the traffic departs from their home at 6-7 reflecting at very sharp curve between 6 to 8 at Jl. Sudirman. However, the situation at evening is flatter, but 16 to 18 is the peak flow of traffic, as shown in Figure 4.

![Figure 4 Hourly Fluctuations by Purpose](image)

Source: PT. Pamintori (2007)

6.2 Jakarta Mode Choice Structure
The TDM strategy “3 in 1” is identified as existing strategy denoted by point 1 splits traffic into public and private movements. Busway Strategy, denoted here as ‘2’, accepted passengers from public and private car, but School Buses ‘3’ splits public transport passenger. On the other way, Staggered Working Hours and Road Pricing are to reduce private car trips. The schematic modal split choices for those 5 strategies is presented in the Figure 6.
6.3 Evaluation of Strategies

All five transport strategy for Jakarta would be assessed by related reports and studies. The parameters used in the evaluation are Trip Served (number of traffic or passenger directly served by the strategy), Speed Change (change of travel speed), and Travel Shift (modal choice changes due to implementation of strategy), Financial Evaluation (investment cost and financial parameters) and Emission Change (change of emission parameters). Table 5 shows the evaluation results.

6.3.1 Do Nothing

The “3 in 1” policy can cater 72,800 pcu/hr, but however it can reduce travel speed significantly during the policy period (06.30-10.00 and 16.30-19.00). The cost of this strategy is quite low, only traffic signs, marking and enforcement, but surely it changes the travel pattern to shift the time to enter the office, unless some “jockey” used their services to make the car occupancy adjusted.

6.3.2 Busway

The implemented 7 corridors could convey 250,000 pax/hr with improvement from increasing travel speed in range of 5 to 15 km/hr. ITDP (2007) estimated that shift from private cars to busway passengers can reach 14% during peak periods. Meanwhile JETRO (2008) on his presentation to Governor reported that busway can reduce pollutant, e.g. 20,000 ton/year CO2 reduction, 23 ton/year PM-10 reduction and 155 ton/year NOx reduction.

6.3.3 School Bus

The 35 school bus started to improve students movements which currently becoming the burden for bus drivers due to his discount fare. The new services can serve 9,600 High School students (Dinas Perhubungan, 2007). Approximately 5% of bus passenger shifts to school bus and it can improve bus speed of 5-10 km/hr on some corridors.
6.3.4 Staggered Working Hours
The staggered working hours study prepared by PT. Pamintori Cipta reported that 55,883 pcu/hr would be reduced by flattering the peak flows 4.5-8%. It also forecasts to reduce congestion by 15.98% in the morning and 7.56% in the afternoon.

6.3.5 ERP
The ERP would improve traffic level by reducing amount of 72,800 pcu/hr (JETRO, 2008). It can also reduce 3.3 million veh-km/day, improve average travel speed by 10-20 km/hr in the TDM area. Emission loading would also reduce, i.e. 4,889 ton CO/year, 839 ton HC/year and 302 ton NOx/year.

Table 5 Forecast of Mode Shift after Applying TDM Strategy for Jakarta

<table>
<thead>
<tr>
<th>No.</th>
<th>TDM STRATEGY</th>
<th>TRIPS SERVED</th>
<th>SPEED CHANGES</th>
<th>TRAVEL SHIFT</th>
<th>FINANCIAL</th>
<th>EMISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Existing Vehicle Occupancy Strategy “3 in 1”</td>
<td>72,800 pcu</td>
<td>+ 8.9 km/h (^2) [30.2 (w) vs. 21.3 (w/o)]</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Development of Bus Priority “Busway” System on Corr. 1-7</td>
<td>250,000 pax</td>
<td>Average: + 5 to 15 km/h (^4) Private Car User Shift to Busway: 14% (^3)</td>
<td>Inv:2,800 b (^4) (infrastructures)</td>
<td>Reduction: CO₂: 20,000 t/y (^1) PM10: 23 t/y (^1) NOx: 155 t/y (^1)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Servicing High School Students Using School Bus</td>
<td>9,600 pax</td>
<td>Average Speed: + 5 to 10 km/h (^4) Congs. Redctn (^2): 5.85% (mon) Public Transport User Shift to School Bus: 5%</td>
<td>Inv:7 b (^4)</td>
<td>n.a</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Staggered Working Hours</td>
<td>55,883 pcu</td>
<td>Congs. Redctn (^2): 15.98% (mon) 7.56% (evng) Peak Traffic Level Reduce 4.5% to 8%</td>
<td>Inv:50 b (^4)</td>
<td>n.a</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Implementation of Road Pricing</td>
<td>72,800 pcu</td>
<td>Average Speed: + 10 to 20 k/h Congs. Redctn (^2): 10% (mon) Veh-km/day Reduction: 3.3 mills. Inv:845 b (^1) B/C: 1.86 (^1) IRR: 30.4% (^1)</td>
<td>Reduction: CO: 4,889 t/y (^1) HC: 839 t/y (^1) NOx: 302 t/y (^1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources:
1. JETRO (2008)
2. PT. Pamintori Cipta (2007)
3. ITDP Jakarta (2007)
4. Authors Estimation

Estimation of mode choice analysis for assessment of public transport and private car trip using 5 TDM strategies results trip splits as presented in Fig.7 below. The residual private car trip estimated only 29.1%, reducing 18.1% from current traffic mode split condition.

Busway is the best practice of urban TDM strategies since; it can influence 250,000 trips with speed increases of 5-15 km/hr, while it can shift 14% of private cars to public transport. It also proves to reduce emission loadings significantly.
7. Conclusion
Jakarta as typical metropolitan cities in Indonesia has been prolonged with serious traffic congestion. The concept of TDM should be appreciated as a tool to improve mobility and accessibility. The estimation of modal split and their performance for 5 TDM strategies is presented. Total private trips if all TDM schemes applied is estimated of 29.1%, from previously 47%, or reduced by 18%. However, busway will be more chances to attract private cars mode shifts.

REFERENCES
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