QUANTIFYING COST BENEFIT OF WALKING AND CYCLING FACILITIES IMPROVEMENT; A PRELIMINARY STUDY FOR METHODOLOGY AND APPLICATION IN JAKARTA

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1. Introduction

The number of Motorized vehicles in Jakarta has been increasing very significantly as shown in Figure1. From 1985 to 2002, car ownership increased approximately three times and motorcycle ownership three and a half times[1]. During the Asian Economic Crisis period, the number of registrations especially for motorcycles suddenly dropped. However, since 2001, with the recovery of economic conditions, vehicle registration has resumed its increasing trend. This phenomena is different in case of Non Motorized Transport (NMT). NMT in here may include walking, cycling and some types of paratransit. Study of SITRAMP 2001 indicates that NMT decreased from 60% (1970s) to 28.8 %. [2]

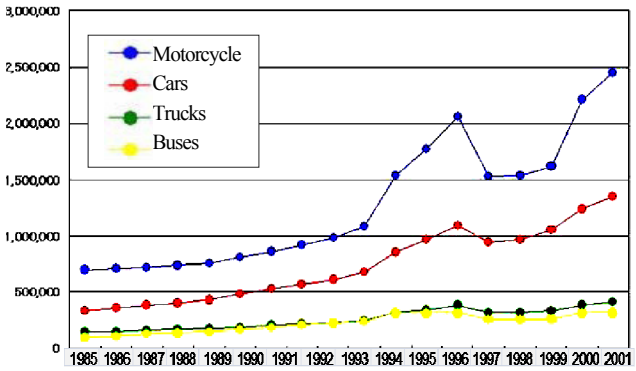

Figure 1: Number of motor vehicles in Jakarta, 2006

NMT role is crucial for livability of cities. It is the main mode in connected with public transportation for the lower income people. It has a very significant poverty impact. However, during the period of motorization in Jakarta, there have been no studies and policies that acknowledged the existence of NMT as a part of the transportation system in Jakarta. Because the lack of information concerning potential usage of NMT, no transportation studies has recommended facilitating the use of these modes[3].

The trend of NMT decreasing above indicates the transportation policy has limited attention to support NMT modes. The principal investment has been made to support motor vehicles development. NMT are seldom included in major urban transportation planning. Subsidies are often only for expensive infrastructure projects and NMT is often overlooked due to a lack of powerful stakeholders.

2. Purpose and Framework

2.1. Purpose

Although NMT improvements do not usually rank as the most cost effective way to overcome Jakarta's transportation problem, they tend to provide many benefits for transportation, environment and community. However, conventional planning tends to undercount and undervalue these modes. Discussion on benefit of NMT is limited to the reduction of congestion only. From this perspective, NMT may have a minor role to play in overall transport system[4].

Experiences with the Cost Benefit Analysis (CBA) of NMT improvements on several indicators in Jakarta are rather limited. In here, it is needed more comprehensive analysis to recognizes and quantify the benefit of NMT on all modes and can therefore identify one of optimal solution against transportation problems in Jakarta.

The objective of this study is to evaluate and quantify cost and benefit of walking cycling facilities development if they are improved in Jakarta. The study will not only provide several approaches to evaluate the benefits of improvement, but also answer the hypothesis that investment on NMT development is one of most cost effective and valuable measures on existing situation of Jakarta.

2.2. Framework of Evaluation

Several methods using Contingent Valuation Methods (CVM) such as Willingness To Pay (WTP), Willingness to Use and other assumptions will be improved as methodology. This study will explain how these methods will be applied for quantifying the benefit of NMT in Jakarta. The analysis will be done with evaluating reliable indicators and standards for Jakarta.

The evaluation will be carried out in five stages as shown in Figure 2. At first stage, we will start by determining location of pilot project for facility's improvement. After then, we will estimate the cost of project based on type and key characteristics of it. In third stage, we will estimate demand for facility usage and the change obtained by the project. In fourth stage, we

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evaluate how project will impact the overall mobility on location and surrounding area. And as final stage, the benefit for facility improvements will be valued.

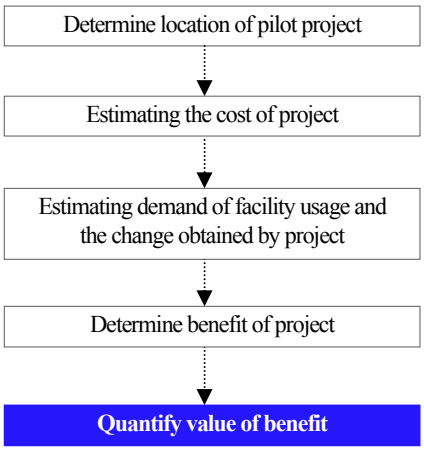

Figure 2: Framework of evaluation

However, this study is, as a preliminary step, designed to propose and discuss methodology that will be applied on further steps of research. Then, the proposed methodology will evaluate and recommend ways to CBA estimating for NMT development facilities in Jakarta.

3. Discussion on methodology of research

3.1. Location of pilot project

A pedestrian mall project has been under construction since 2007 on Kota tua area, Central Jakarta as shown in Figure 3. The project also included the restoration of areas along the Besar River. If the project is completed, the speed of vehicles entering pedestrian area will be restricted under the 30 kilometer per hour.

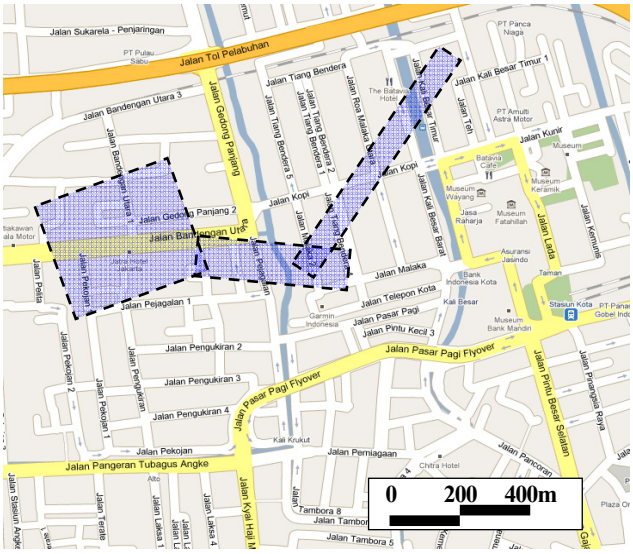

Figure 3: Pedestrian Mall Kota Area

In case of cycling initiative, there is a new thinking way of Government to build first Jakarta's cycle lane that will be developed from Jl. Lebak Bulus to Jl. Pondok Metro as shown in Figure 4. It then passes Jl. Kyai Maja to Jl. Sisingamaraja. The section from Jl. Lebak Bulus to Jl. Sisingamaraja will be specially marked on sidewalks is shown as section I. Also, government planned to divide existing sidewalk in Jl. Jend. Sudirman–Thamrin into pedestrians and cycling spaces is shown as section II. For area with narrow sidewalks like the Kuningan, the lane will occupy a space in the street is shown as section III.

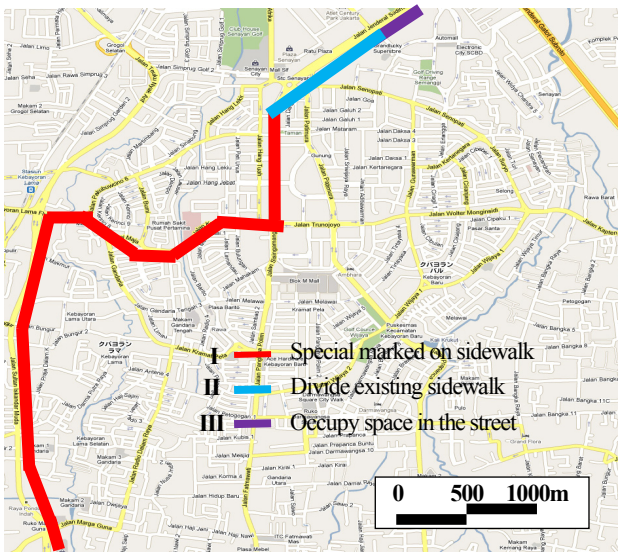

Figure 4: Cycling lane initiative in Jakarta

3.2 Methodology for estimating the cost of project

Costs are generally easier to measured and valued than benefits. Typical costs of a pedestrian and cycling space for project improvement are calculated for:

- Construction
- Operation
- Maintenance
- Interest rate and depreciation

Table 1: Construction elements

Cycling	Shared	Walking
Pavement marking	Earthwork	Benches
Bicycle Parking	Pavement	
	Drainage	
	Landscaping	
	Underpasses	
	Signs	
	Traffic signals	
	Barrier	
	Lighting	
	Security	

After identifying location and type of facility, the next step is to identify the construction elements required for facilities. Table1 shows construction elements that are exclusive to walking and cycling facilities or shared between them. Here we have to note that most elements are shared and included on estimating[5].

For estimation of this study, project improvement will be appreciated with discount rate amounts to 6.50 percent per year

for 10 years, based on decisions by the Central Bank of Republic of Indonesia.

3.3. Methodology for estimating demand by project implementation.

For this study, demand estimating will be based on two different calculations: estimating the total number of pedestrians and cyclists in current condition, and estimating the number of additional pedestrians and cyclists after project implementation[6].

The data will come from a standardized questionnaire survey that will be conducted on August 2010 in Jakarta. A quota sample (residential area, age, gender, education level) will be considered. Three different demand scenarios will be estimated : (1) a change in the number and/or share of trips using walking and cycling ; (2) a change in the number and/or share of trip kilometers by pedestrians and cyclist; and (3) a change in the amount of time spent for walking and cycling.

Using a questionnaire, this study also ask respondents about their trips such as purpose, distance, duration, etc for additional reference. Demand will be estimated from the following question:*"If facilities are improved, how significantly influence your willingness to walk and use bicycle more than currently?"*

Table 2: Benefits of improvement for walking and cycling facilities

	Category benefit	Contents
ΔBh	Improving Health (Rp/Year)	There is overwhelming evidence that physical inactivity increase the risk of several diseases. Activities for walking and cycling everyday would have a major effect on the prevention of a number of illnesses.
.ΔBa	Safety-Accidents (Rp/Year)	Walking and cycling with safe facilities will reduce the number of traffic accidents involving pedestrians and cyclist and vehicles driver.
ΔBcc	Vehicle Cost (Rp/Year)	Walking and cycling is not only a cheap mode of transport for society, the mode individual users can save money through such use.
ΔBpc	Parking Cost Saving (Rp/Year)	Reduced automobile trips may simply result in unoccupied parking spaces. Space can be rent, sold or converted to other functions.
ΔBsc	Security and Enjoyment (Rp/Year)	Many people enjoy walking and cycling, as indicated by their popularity as recreational activities. Walking and cycling is the most popular form of physical recreational activities. Improvement of walking and cycling conditions (such as sidewalks security improvement, lighting, etc.) can provide benefits for user enjoyment.
ΔBec	Pollution(Rp/Year)	A clean and quiet means of walking and cycling can help to reduce urban air pollution and noise nuisance.

3.4. Benefit of project

The impact of improvement is consist of qualitative and quantitative issues. Qualitative impacts are enjoyment, security, safety, etc. Quantitative impacts are health, air pollution,etc[7]. Some impacts are measurable and other impacts can be particularly hard to value, but are not less than the others. In this study, we consider benefits can be realized by improvement of walking and cycling facilities as shown in Table2.

3.5. Methodology to Quantify the Benefits of Health, Safety and Air pollution.

This study will quantify benefits of facility improvements in Table 2 above. However, in this section, we try to discuss methods how some kinds of benefits will be quantified and valued. Of course, as actual benefits will vary according to specific conditions, so these values should be adjusted appropriately to reflect a general situation in Jakarta.

The valuing benefit will be discussed as follows:

1. Improvements in health by regular physical activity of new cyclists (quantification of impacts is based on costs of risk illness),
2. Improvement in safety (based on accident costs),
3. Changes in atmospheric pollution (based on effect of air pollution reduction).

3.5.1. Benefit of Health

There is overwhelming evidence that physical inactivity increase the risk of several diseases. On the contrary, it is possible to reduce mortality risk by increasing the level of physical as shown in Figure5[8].

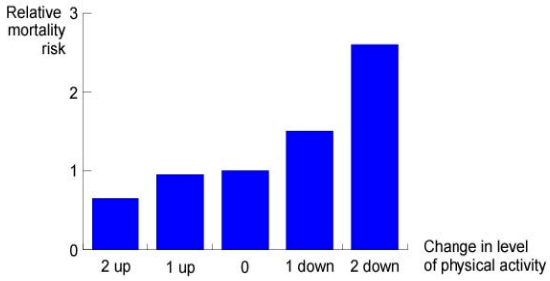

Figure 5: Physical activities and relative mortality risk

This study will estimate the value of health benefit (ΔBh) based on following Equation1 :

$$\Delta Bh = MC2 - MC1 \text{ (Rp/Year)} \ldots\ldots\ldots (1)$$

Where, MC2 : After implementation (Rp/Year)

MC1 : Before implementation(Rp/Year)

After this study calculates demand usage for improved facilities, health benefits will be valued through threes important steps as shown in Figure6.

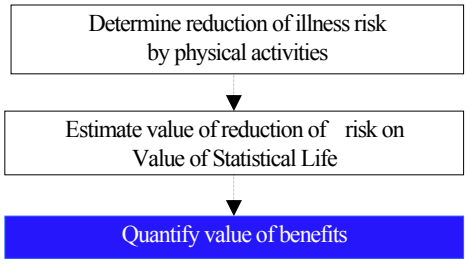

Figure 6: Major Steps for valuing health benefit

Discussions are still ongoing as for which types of diseases can be reduced by physical activity and how significant should be the effect of its. Table3 summarizes the findings of Europe and WHO standards.

Table 3: Disease risk reduction by moderate exercise (%).

Disease	Denmark 2003	WHO 2003	Swiss 2001	Practicable Standard
Hypertension			32	30
Cardiovascular disorders	40	33	46	40
Diabetes	>20		47	40
Osteoporosis	50		50	50
Breast cancer	50	20-25	28	40
Colon cancer	50		47	40
Gallstone	34			-
Depression			68	-
Back pain			26	-

The next question is Value of Statistical Life (VSL) for Jakarta. VSL is an economic value assigned to life in general, commonly determined by looking at a person's WTP. In this study, value of VSL for Jakarta's standard will be identified by asking respondents how much they would be willing to pay for good health outcomes.

3.5.2. Benefit of Safety-Accidents

WTP and Gross Output are the two methods, which are usually used to quantify the value of safety. Based on WTP method, respondents will be asked to answer questions as follows: How much are you willing to pay for reducing a accidents probability risk. And, Gross Output is the method for calculating accident cost by analyzing the casualty cost. The casualty cost is divided into two components, *Direct and Indirect Cost*[9].

Direct Cost in this study encompasses some items which are: cost at accident, hospital cost, patient treatment, psychotherapy, and other cost. And, *Indirect costs* are divided into two components. First, loss of productivity, incurred in respect of the loss of productive working time for casualties as a result of the accident. Estimating will be done by using the loss of casualties working time multiplied by their income or wages. And Second, loss of quality of life is the cost covering pain, grief and suffering as a result of the accident that could reduce the quality of life.

The developing country including Indonesia has been using Gross Output for valuing cost of safety. However many studies conclude that Gross Output is inappropriate for calculating human cost of non- fatal accident. On the other hand, WTP is appropriate to value non fatal accident but tends to give the 'insensitive' to risk reduction. Therefore, this study tries to value the cost of safety by combination of Gross Output and WTP method based on data collection and questionnaire survey as shown in Figure7.

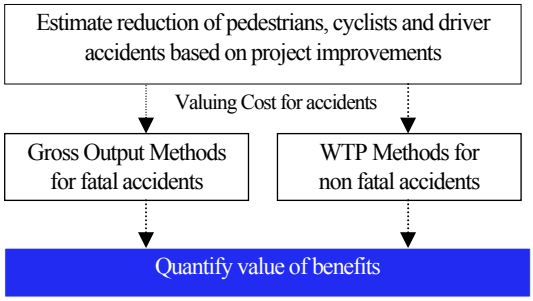

Figure 7: Major steps valuing safety benefit

We will estimate value of safety benefit (ΔBa) based on following Equation2[10].

$$\Delta Ba = C ac \times \alpha \times \Delta Tcar \text{ (Rp/Year)} \ldots\ldots (2)$$

Where, Cac : Cost for accidents (Rp/ Year)

α : Probability of accident risk by using car (Case/min)

ΔT : Change of trips (Min/Year)

3.5.3. Benefit of air pollution reduction

Emission from motor vehicles causes significant damage to environment and human health. People who are exposed to high levels of emissions may suffer from respiratory disease, lung damage, or even cancer[11].

In this study, analyses of emissions will focus on the effects of air pollution on human health and they typically will consider the types of emissions such as: Carbon monoxide (CO), Nitrogen oxides (NOx), Sulfur oxides (SOX), (VOC) and Fine particulates (PM10).

The basic equation for estimating benefit of air pollution reduction (Δ Bec) is shown in Equation3 :

$$\Delta Bec = \Delta ec \times \alpha \times P \times Ev \text{ (Rp/Year)} \ldots\ldots (3)$$

Where, Δec : Change in emission concentration

α : Exposure Response Cofficient by each emission.

P : Population at risk

Ev : Unit Economic value.

The process of this evaluation consists of three important steps as shown in Figure8.

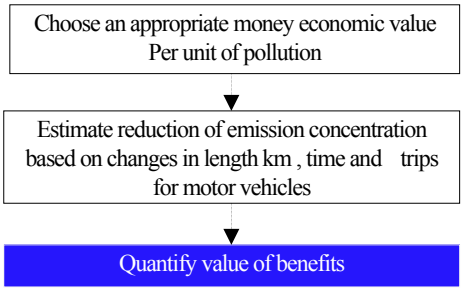

Figure 8: Major steps for valuing air pollution reduction benefit

The next question is what methods can be applied to determine the economic value per unit of pollution. In this study, the combination methods of WTP and *Cost of illness (COI)* will be used.

As this study explained above, in WTP method, respondents will be required to answer questions on how much they are willing to pay for reducing occurrence of disease (morbidity) and the risk of death (mortality). And, *Cost of illness (COI)* is the method to measure all costs associated with a particular disease or condition including medical costs, hospitalization and loss of wages due to illness. The basic estimating data of this method will come from hospital and health insurance company.

4. Conclusion and Next Steps

This study is located as a preliminary step to discuss the framework of methodology, in order to evaluate cost and benefit of waking cycling facilities improvement in Jakarta. Some benefits are measurable and other benefits are hard to valued, but we know that their impacts are significant. Therefore, further qualitative study for quantifying value of these benefits will become the next proposal for this research.

However, the reason for inclusion the theme of CBA is to show an example of how beneficial NMT can be obtained from several view points. Although improvement infrastructure for motorized transport is important, existing walking and cycling facilities in Jakarta also have extremely beneficial to be developed as well as the improvement of public transports. Executing CBA of walking and cycling will show the hidden benefits of NMT, thereby decision maker can put development of these modes as priority on the decision agenda.

Relatively few researches have been conducted on this field in Jakarta. Therefore, as a particular objective, this study will help the government, municipal and decision maker to know the significance role of NMT for the future.

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