Formulation of Transportation Action Plan for the Surabaya Metropolitan Area

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Abstract: GERBANGERTOSUSILA (GKS) Zone in East Java Province is the second largest economic sphere in Indonesia. In GKS, a large urban area extends from the city of Surabaya to the surrounding Kabupatens (regencies), and it is particularly called the Surabaya metropolitan area. While the overall objective of the Study is to formulate the Spatial Plan for GKS, this paper presents the Study approach for ongoing work of developing urban transportation action plans for the Surabaya metropolitan area. The transportation demand forecast model in this Study benefits from a wide variety of surveys that are conducted including a commuter survey, a road traffic survey, a trip diary survey, a travel speed survey, and an opinion survey, enabling the model to include not only improvement of the road and public transport systems but also analysis of traffic demand management policies. Preliminary results of those surveys will also be included in the presentation.

Key Words: transportation plan, spatial plan, Surabaya metropolitan area, GERBANGKERTOSUSILA, East Java

1. INTRODUCTION

1.1 Background
GERBANGERTOSUSILA (hereinafter referred to as “GKS”) Zone in East Java Province is the second largest economic sphere in Indonesia. It consists of five Kabupatens (regencies) and two Kotas (cities), namely, Kabupaten Sidoarjo, Kabupaten Mojokerto, Kabupaten Lamongan, Kabupaten Gresik, Kabupaten Bangkalan, Kota Mojokerto, and Kota Surabaya. A regional development master plan of the GKS Zone was formulated with the assistance of Japan International Cooperation Agency (JICA) in 1983.

GKS has urbanized rapidly and accompanied by inefficient development causing urban problems, in particular, air pollution and traffic congestion. Although investment and the development of infrastructure in GKS have slowed down after the economic crisis in 1997, it is observed that the population and economic growth have become larger than those before
the economic crisis. The Sumadura Bridge over the Madura strait linking Surabaya and Madura Island is currently under construction and scheduled to be open in 2009; it is expected to create a new regional development corridor. Under the circumstances, the need to formulate a new regional Spatial Plan for GKS has arisen.

In Indonesia, the Spatial Planning Law which was amended in April 2007 stipulates that national, provincial, Kabupaten, and Kota governments must prepare a Spatial Plan. The National Spatial Plan was formulated in March 2008, based on which provincial governments are formulating their Spatial Plans. Subsequently local governments of Kabupatens and Kotas are supposed to prepare their Spatial Plans by April 2010 based on the Provincial Spatial Plans. A Spatial Plan for a metropolitan region like GKS, when needed, can be formulated because GKS is one of the national strategic regions, and the planning work is supposed to be conducted by the initiative of the Directorate General of Spatial Planning, Ministry of Public Works.

Under such circumstance, in response to the request of the Government of Republic of Indonesia, JICA, the official agency responsible for the implementation of technical cooperation programs of the Government of Japan decided to conduct “Development Study on Formulation of Spatial Planning for the GKS Zone in East Java Province in Indonesia” (hereinafter referred to as “the Study”) from March 2009 until September 2010.

1.2 Study Objectives

The objectives of the Study are as follows:

- To formulate the Spatial Plan for the GKS Zone with the target year of 2030,
- To prepare the action plans for urban transportation in the area, and
- To strengthen the capacity of the counterpart personnel and institutions in the course of the Study.

While the overall objective of the Study is to formulate the Spatial Plan for the GKS Zone of approximately 5,800 sq. km (Figure 1), the Study also focuses on formulation of the action plan for the urban transportation in the Study area. As such, thorough and detailed transportation surveys and analyses are undertaken to prepare the urban transportation action plans. In the GKS Zone, a large urban area extends from Kota Surabaya to the surrounding Kabupatens, and it is particularly called the Surabaya metropolitan area.

The survey program associated with the Study is of considerable scope. As described in the next chapters, a total of five transportation surveys are carried out in order to obtain various data on socioeconomic indicators, person trip movements, freight patterns, transport operations, transport infrastructure, and public opinions. This paper presents the Study approach as well as the tasks of the Study with a focus on transportation planning including the outline and result of those transportation surveys.
2. FORMULATION OF A COMPREHENSIVE TRANSPORTATION PLAN TO ALLEVIATE TRAFFIC CONGESTIONS

2.1 Traffic Infrastructure Development to Meet Increasing Urban Traffic Demand
Traffic infrastructure development in GKS has not made much progress. When one compares the present road network to what it was at the time of the 1983 Plan (JICA and PU 1983), it is clear that there has been little change. On the other hand, the usage of motorcycles and passenger vehicles has increased year by year. The increase in the number of motorcycles in particular has been remarkable, the same as in the other major cities of Indonesia.

In terms of occupying limited urban road space, motorcycle usage does not cause as much a problem as passenger vehicles in terms of traffic congestion but the shift to motorcycles results in a decline in public transport usage which in turn affects the profitability of public transport projects. It is also a problem in the sense that motorcycle users have a habit to switch eventually to automobiles.
2.2 Accurate Understanding of Current Situation and Forecasting Future Demand

When considering measures to combat urban traffic congestion, it is vital that one understands how many people are currently traveling from where to where, using what mode of transport and which route as well as how it will be in the future. Then based on this information one can identify current problems, forecast future traffic demand and evaluate policies.

East Java Province has come up with a provincial transportation plan called “TATRAWIL 2008-2028”, and created infrastructure programs for road, railway, airport, port, and waterway transport. However, when it comes to the current traffic situation it has only surveyed the existing facilities and has not yet analyzed present or future traffic demand. Although there is an origin-destination (OD) table for the whole country conducted by the Ministry of Transportation in 2006, it is at a Kota/Kabupaten level and is not of sufficient accuracy for traffic policy analysis at the metropolitan level.

Generally a person trip survey is carried out for the whole metropolitan area when one is studying measures to combat urban traffic problems, but it requires time and cost. Thus this
survey has directed its attention on the flow of commuters which has an acute effect on traffic congestion. A simple interview survey called Commuter Survey is targeted at 3% of households in the Surabaya metropolitan area consisting of Kota Surabaya and part of Kabupaten Gresik, Kabupaten Sidoarjo, and Kabupaten Bangkalan focusing mainly on the flow of commuters. In addition, after carrying out a series of surveys regarding the present urban traffic such as Road Traffic Survey, Trip Diary Survey, Travel Speed Survey, and Opinion Survey, an accurate understanding of the current situation can be obtained, and future demand can be forecast.

2.3 Improvement Plan for Traffic System in GKS
In an effort to improve public transportation in GKS, PT. KA, which is the sole railway operator in Indonesia and a wholly state-owned company, has already implemented “SUSI” which aims to improve the commuter rail service between Surabaya and Sidoarjo. This is being carried out with French assistance. In addition, a feasibility study on extending the commuter railway from Surabaya to Gresik is being carried out also with French Aid. Meanwhile, Kota Surabaya is planning to establish a BRT (Bus Rapid Transit).

2.4 Formation of Functional Public Transportation Network with Wider Coverage
The greater usage of public transport cannot be hoped for by only modifying or improving one route. The middle class has shied away from public transport because the mini bus service paid little attention to passenger convenience. It is necessary to create a public transportation network that can provide the level of service that even this group would want to utilize.

2.5 Improvement of Inter-modal Mobility
In terms of promoting use of public transport, if BRT is to be established in the East-West direction in tandem with the current improvements being made to the North-South railway service between Surabaya and Sidoarjo, then a transfer facility allowing smooth connection between the two is vital. In addition, in order to promote railway use, station plaza area and feeder bus service should also be considered at the same time.

2.6 Integration with Transportation System and Appropriate Land Use
In order to effectively use public transportation as a means to combat urban traffic problems, one should not only improve the railway system, but also ensure that the surrounding land is used in such a way as to encourage the use of trains. In this Survey, both land use and transportation facility infrastructure can be examined under the same survey. Transit Oriented Development (TOD), the promotion of high-density land use around train stations, will also be examined as one of the issues.

The GKS Spatial Plan required of this Survey is a scale of 1:100,000 but it is believed that a more detailed land use plan (which includes setting land use, building-to-land ratio, and floor area ratio) should be proposed for land use around stations. If this need is explained to the Indonesian side and a specific land use plan can be presented, there is a high likelihood that it will be incorporated into the Kota/Kabupaten Spatial Plan currently being prepared by the Kota/Kabupaten governments of GKS, and become the legal plan supported by regulations. Once certified as a legal plan, one can expect a gradual change towards land use which would be more suitable for public transportation usage.

2.7 Pursuance of Possible “Bus Rapid Transit (BRT)” Infrastructure Development
Since there are wide arterial roads in Jakarta, work is underway to create eight busway routes; also, the BRT network is becoming more convenient. Other cities in Indonesia are also trying
to establish busways as well, but since there are not many wide arterial roads in Surabaya, only a limited amount of work can be done in the short-term.

Due to this situation, the BRT plan for Surabaya calls for the building of an elevated busway. However, the cost of an elevated busway is expected to be substantial and so a feasibility study of the project ought to be carried out.

2.8 Establishment of Wide Arterial Road Network
As mentioned earlier, trunk road infrastructure development in Surabaya is lagging. Therefore, the construction of arterial roads is an urgent matter. It would be ideal if space for public transportation, such as busways, could be reserved within the middle of arterial roads as this would allow road and public transport infrastructure to be put in place simultaneously. Discussions will be carried out with the relevant local authorities regarding this possibility.

2.9 Introduction of Measures for “Traffic Demand Management (TDM)”
Just as it was considered essential in Jakarta to have a public transportation network in place before a traffic demand management policy (such as road pricing is introduced) in order to provide people an alternative, it is necessary to set up a public transportation system in Surabaya with a level of service that is attractive enough for vehicle users to switch to. Presently the service level of the public transportation system is low, and this needs to be remedied before any traffic demand management policy is implemented.

3. TASKS OF THE STUDY

3.1 Survey of Current Conditions of Urban Transportation
As mentioned in the previous chapter, a trip movement survey based on a person trip survey has not been conducted recently in Kota Surabaya or GKS, and the existing OD table is available only on a level of a national OD survey. Five kinds of transport-related surveys, as summarized in Table 1, are carried out as part of the survey of current conditions of urban transportation in order to obtain the trip movement for each mode that is detailed enough for the analysis of urban transportation problems and forecast of future traffic demand. Most of
the surveys are conventional in terms of the objectives and methodologies. Nevertheless, the following approaches are noted.

Commuter Survey in particular is a new undertaking which looks mainly at commuters of each household. A normal person trip survey requires a survey for each trip, and needs an enormous amount of time and money for investigation and compilation, but this survey is able to create an OD table of high accuracy in an efficient manner by focusing on the flow of commuting trips which have a big impact on congestion.

Weighbridge Survey is also another new undertaking that was carried out as part of the “Study on Development of Regional Railway System of Central Java Region.” Weighbridges have been set up to monitor overloading at key Kabupaten borders and by inspecting cargo vehicles at these points one can obtain very precise flow of freight traffic.

It is also possible to find out detailed travel speeds of almost all roads within the whole Kota Surabaya by time period and days of the week through a Travel Speed Survey using taxis which is also a new approach. A sample diagram of the results from this survey is as shown below.

Table 1 Outline of surveys on current condition of urban transportation

<table>
<thead>
<tr>
<th>Survey</th>
<th>Objective</th>
<th>Summary and Scale of Survey</th>
<th>How Results will be Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Commuter Survey</td>
<td>To understand the travel characteristics of commuters and create an OD table for the Surabaya metropolitan area.</td>
<td>Conduct a survey by visiting approximately 3% of the households in Kota Surabaya, and part of Kabupaten Sidoarjo, Kabupaten Gresik, and Kabupaten Bangkalan (roughly 48,000 households, 160,000 persons), and obtain data on individual attributes: place of commute, departure and arrival times,</td>
<td>Survey will allow understanding of the flow of commuting trips which has a strong impact on congestion within the city, and create an OD table of high accuracy within a short</td>
</tr>
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<tr>
<td>Classifed Traffic Count Survey</td>
<td>To understand the road traffic volume and congestion situation</td>
<td>Observe the traffic volume by vehicle type at 32 locations along main roads in GKS. Survey period shall be for 24 hours at the locations along main roads, and for 16 hours at the remaining locations namely from 6 am till 10 pm.</td>
<td>To understand the growth in vehicle traffic by comparing with previous surveys such as ARSDS (1996)</td>
</tr>
<tr>
<td>Roadside OD Survey</td>
<td>To understand inter-regional trip movement in GKS for use as basic material for creating current OD table</td>
<td>Conduct a roadside interview by stopping roughly 25% of passing vehicles at 31 locations along main roads and asking about points of origin and destination, attributes, etc. For large buses, passengers are interviewed onboard. The Survey locations are along the borders of the Surabaya metropolitan area, GKS, and Kabupaten, as well as Tg. Perak Port. Survey period shall be for 16 hours, namely from 6 am till 10 pm.</td>
<td>By creating an OD table for cars and bus passengers and understanding the trip movement within GKS region, the current traffic problems can be understood and at the same time used to forecast future traffic demand</td>
</tr>
<tr>
<td>Weighbridge Survey</td>
<td>To understand the broad flow of freight traffic including the surrounding areas, and create an OD table categorized by item</td>
<td>In Indonesia weighbridges for monitoring overloaded vehicles are located at key kabupaten borders, and all vehicles must undergo weight inspection except for empty lorries, containers and tankers. Approximately 25% of vehicles passing through at all weighbridges within GKS will have their weights recorded and questioned about OD, cargo, and attributes. Survey period will be over 24 hours</td>
<td>The same survey was carried out under JICA and Dephub (2009), and a highly accurate OD table by commodity type was created. This Survey will also create an OD table in order to understand the movement of goods within the region</td>
</tr>
<tr>
<td>3. Trip Diary Survey</td>
<td>To review the trip generation rate, and use to forecast current and future traffic demand</td>
<td>Taking the distance from central Surabaya and the socio-economic situation into consideration, 20 kelurahans/desas (villages) will be selected with 50 households from each one being interviewed, or a total of 1,000 households. The interviewer will visit each household, explain the purpose, distribute the survey form, and get them to record their activities every 15 minutes regardless of whether they are in the house or outside for a period of 2 days. The interviewer will later collect the forms.</td>
<td>Allow accurate understanding of the trip generation rate in order to forecast future traffic demand</td>
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<tr>
<td>4. Travel Speed Survey</td>
<td>To understand the congestion situation within the city and travel time</td>
<td>About 50 taxis are installed with GPS and a data transmission system using mobile phones, and asked to operate as usual for roughly 1 month within Kota Surabaya. The position data will be gathered at a server on a real-time basis in order to obtain the average travel speed by section for all streets within Kota Surabaya.</td>
<td>Since detailed data can be obtained for all roads by time and day of the week, it is possible to obtain detailed information about localized congestions which can be used as basic material when studying</td>
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<td>5. Opinion Survey</td>
<td>To construct a travel mode choice model in order to understand what the usage will be like if a new traffic policy were to be introduced</td>
<td>Conduct an interview survey targeting roughly 500 residents living along the planned public transportation routes as well as roughly 500 current users of public transport in order to understand current public transportation usage, possibility of using the new public transport, and individual attributes. The Survey will be carried out at the same time as when the transportation action plans are being studied.</td>
<td>Can be used to study the benefits brought about by the policies proposed by the transportation action plans</td>
</tr>
</tbody>
</table>

Figure 6 Locations for conducting road traffic survey (within Kota Surabaya)
3.2 Future Traffic Demand Forecast

3.2.1 Forecasting Trip Production and Attraction Volume by Zone
Firstly the future social and economic framework for the whole GKS region will be set up. For this it is necessary to analyze the future trends such as population, Gross Regional Domestic Product (GRDP), working population by industrial sector, and number of vehicles owned. Furthermore, as the next step this framework needs to be broken down to more detailed levels for traffic analysis zone, nighttime population by income group, working population by residential place by industrial sector, working population by workplace, number of students by residential place; the number of students by school place will be needed as indices at this traffic analysis zone level.

In order to study the impact on the traffic system for each alternative land use plan, these indices shall be estimated for each traffic analysis zone according to the land use plan, and then the trip generation will be calculated.

3.2.2 Forecasting Trip Distribution Volume
The current distribution of work-trips and school-trips for the Surabaya metropolitan area can be estimated through expanded aggregation of the Commuter Survey carried out in Kota Surabaya and part of Kabupaten Gresik, Kabupaten Sidoarjo, and Kabupaten Bangkalan for the person-trip based OD table. For trips of other purposes, the Trip Distribution Model can be estimated separately from the Trip Diary Survey and the current status can also be deduced from the model. The future can be forecast by using the above mentioned future trip production and attraction volume by zone as input and applying the zonal impedance.

3.2.3 Forecasting Modal Split Model
Once the trip distribution volume between each zone has been obtained in the form of OD
table, the trip distribution volume will be broken down into passenger vehicle, motorcycles and public transport trips using the mode choice model. Since the required time and cost between zones will differ depending on the level of road network and public transportation infrastructure, forecasting should be carried out for various case scenarios with different degrees of infrastructure.

3.2.4 Forecasting Network Assignment
The passenger car trips and motorcycle trips shall be converted to vehicle trips, and then distributed throughout the road network together with the separately estimated OD table for trucks in order to forecast the traffic volume by road section. For public transport trips, the traffic volume by route and road section can be forecast by outlining the future public transport network as well as its operation frequency and fare and distributing the person-based OD table onto the public transportation network.

3.3 Examination of Transportation Development Plan
Several Land Use Plans will be presented in the course of examination of alternative land use plans. Here, the most ideal alternative transportation system for these Land Use Plans is presented. Land use and transportation system planning should be carried out together, and the alternative transportation system should be prepared after understanding the background behind the alternative Land Use Plan.

Since transportation infrastructure exerts a strong influence on the direction of development, if the direction of urban development has been stipulated due to some restrictions, the transportation system infrastructure should be examined as a tool to guide the direction of development towards the desired urban structure.

For example, the “Arterial Road System Development Project in GERBANGKERTOSUSILA Region (Surabaya Metropolitan Area) in the Republic of Indonesia” (JICA, 1996) proposed the policy of gradually building a trunk road infrastructure from near the city center in a grid format in order to extend the Kota Surabaya’s urban district in the east-west direction. This is the case of a transportation system infrastructure strategy being recommended in order to encourage urban expansion in the strategically desirable east-west direction.
3.4 Formulation of Transportation Development Plan
In order to come up with a Transportation Infrastructure Development Plan, the alternative transportation system outlined in the previous section will be evaluated in terms of technical feasibility, economic and environmental assessment, and implementation feasibility and a long-term transportation plan extending to 2030 will be created. The projects which are part of the long-term plan will be prioritized, and with 2010 being the starting point, the ones which are to be completed by in the short term (i.e., by 2015), and mid-term (2020), will be identified and put in an implementation schedule.

3.5 Examination of Action Plans of Urban Transportation
The content of the Urban Traffic Action Plan that was outlined in the previous section for implementation by 2015 will be studied in greater detail. It is not possible to specify the projects to be included in the Action Plans of Urban Transportation at this stage, but since the requirement is to deal with such transportation problems such as traffic congestion, one can assume that developing and improving public transportation infrastructure will be one of key items.

3.5.1 Road Network Infrastructure
As mentioned in the previous chapter, the development of wide arterial road infrastructure has not progressed along the east-west corridor, and those sections which are of high priority in the short term, including the possibility of building arterial roads with space for public transport, should be identified and an action plan should be formulated.

3.5.2 Public Transportation System
In a developing country like Indonesia where citizens are unable to pay high fares, simply
improving the public transportation system will not result in increased usage, and there are many cases of infrastructure being unable to achieve its potential. Therefore, when developing public transportation infrastructure one must not only plan the system but adopt an integrated approach such as improving access to related projects and transfer terminals, encouraging high density land use around stations, and re-development projects within the city center.

3.5.3 Traffic Demand Management
Also, it may be necessary to consider a traffic demand management policy like the road pricing which is being planned in Jakarta depending on the situation. In recent years, from a realization that a supply side only approach has its limitations in dealing with urban transportation problems, many cities in the world have studied the idea of traffic demand management and several have implemented it. However, to consider the possibility of introducing it in the Surabaya metropolitan area the prerequisite would be to have the alternative options in the form of a sufficient public transportation network covering the metropolitan area; thus, the timing has to match with the public transportation infrastructure development.

4. SUMMARY
This paper presented the study approach for developing urban transportation action plans for the Surabaya metropolitan area. While this paper presents the study in progress, initial results of analysis of the current conditions of transportation will be presented in EASTS Conference 2009. The transportation demand forecast model in this study benefits from a wide variety of surveys including a commuter survey, a road traffic survey, a trip diary survey, a travel speed survey, and an opinion survey, enabling the model to include not only improvement of the road and public transport systems but also analysis of traffic demand management policies. Furthermore, by making the most of the survey results, more powerful and practical modeling tools are to be developed in order to better understand travel behavior helping policymakers to better analyze the benefits and costs from implementing different transportation policies.

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REFERENCE

