

INTRODUCING A NEW PUBLIC TRANSPORT MODE FOR MIDDLE CITIES IN INDONESIA

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abstract: Based on the passenger capacity, urban mass transportation system can be divided into 4 (four) categories, namely: bus, tram, Light Rail Transit (LRT) and Heavy Rail Transit (HRT). The Guided Light Transit (GLT) system can be categorised as a combination of the tram and bus design, and is suitable for middle cities with population between 0.5 and 1.5 million. For the purpose of introducing the GLT technology in Indonesia, BPP Teknologi in cooperation with Bombardier EURORAIL has undertaken a study to select some potential cities for the implementation of GLT system. This paper explains the process, methodology undertaken and the result of the GLT implementation study in some middle cities in Indonesia.

1. INTRODUCTION

In order to develop a mass public transportation system for large and middle cities in Indonesia, there is a need of an efficient, effective, safe and affordable transportation system. Based on the passenger capacity, urban mass transportation system can be divided into 4 (four) categories, namely: bus, tram, Light Rail Transit (LRT) and Heavy Rail Transit (HRT). How to choose the appropriate mode will depend on the number of passenger demand along the public transport network.

The Guided Light Transit (GLT) as one of the urban public mass transit system, can be categorised as a combination of the tram and bus design, and is suitable for medium-sized cities with population between 0.5 and 1.5 million. In big cities with the population more than 1.5 million the GLT system can operate as feeder or distributor connected to a mass transport system.

For the purpose of introducing GLT technology in Indonesia, Agency for the Assessment and Application of Technology (BPP Teknologi) - the government agency which is responsible for approving new technology in Indonesia - in cooperation with Bombardier EURORAIL has undertaken a study to select some cities which can be considered as potential candidates for the implementation of GLT system (Bombardier EURORAIL and BPP Teknologi, 1995).

The objective of the study are:

- to identify the potentialities of different sites in Indonesia in order to implement a GLT system
- to recommend 2 (two) middle cities for further GLT implementation studies
- to conduct more detailed feasibility studies for those two cities

In addition to those two cities, Batam Island has been chosen as a pilot project for the implementation of GLT system in Indonesia.

2. GUIDED LIGHT TRANSIT (GLT) SYSTEM

The Guided Light Transit (GLT) is a modern lightweight transport system which unites the advantages of bus and tramway in providing an attractive and effective transport solution to meet the economic and social demands of developments facing middle cities today.

The GLT system is a bimodal vehicle which means it has two modes of operation. It can operate as a guided tramway powered from overhead catenary or it can operate free from its guided mode by switching to an on board diesel generator.

The technical characteristics of GLT system are summarised on the Table 1 below.

Table 1. GLT Main Characteristics

Characteristic	Value
Length	24.5 m
Width	2.5 m
Height	3.3 m
Total Capacity	150 P
Seated	45 P
Standing (4 P per m ²)	105 P
Maximum Speed	80 Km/H

Based on the maximum capacity (150 pass/vehicle) and assuming an operational GLT line with a frequency of one vehicle each 2 minutes (30 vehicles/hour), the GLT offers a capacity of 4500 passengers per hour per direction.

It means that the GLT can serve as the backbone of a public transport network in medium-sized cities which have a population less than 1.5 million. Buses (small, medium, large) can act as feeder or distributor of passengers carried by the GLT on a main axis.

3. METHODOLOGY

3.1. The Process of the Study

The methodology used for selecting some cities as potential candidates for the implementation of GLT system consisted of 6 stages as seen in Figure 1.

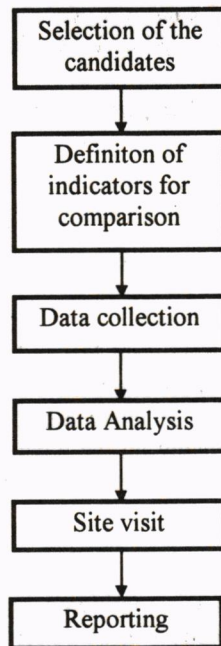


Figure 1. Structure of the study

Detail of the structure of the study as shown in the above figure is explained below.

- For selecting the candidates a GLT presentation was organised. Representatives from middle cities all over Indonesia were invited. After the presentation it was asked to the representatives of the cities to express their interest in an possible GLT presentation. Based on the reaction from the cities a first selection was made. Following middle cities were selected:
 - Medan
 - Palembang
 - Denpasar
 - Manado
 - Ujung Pandang
 - Semarang
 In addition to those middle cities, Batam Island was chosen as a Pilot Project for the Implementation of the GLT system.
- The indicators for the comparative assessment of the different cities were then defined.
- The basic information related to the list of indicators such as: existing plans, planning studies, development plans etc were collected from each city.
- The data were then analysed in order to indicate the missing element and add new elements to the list of indicators for comparison.
- Based on the result of data analysis, the study team went to all sites to collect missing data, to contact the local authorities and to make a video recording of the proposed track(s) for the GLT.

- Finally, a report was produced containing the result of the comparative assessment and then a recommendation for making further detail study of the chosen cities was made.
- Further detail studies of the GLT implementation were then conducted for the most potential candidates.

3.2. Qualitative Indicators

Following indicators are used for the comparative assessment:

- **Population**
The GLT system, positioned in between the bus and tram system, can be the backbone of the public transport system in Indonesian cities with a population between 0.5 and 1.5 million. Cities with a number of inhabitants lower than 0.5 million still offer opportunities for the future (depending on the population growing rate). Cities with a number of inhabitants higher than 1.5 are recommended to look for a bigger capacity system, such as: LRT, HRT.
- **Socio-economic growth rate**
A high socio-economic growth rate is considered as a positive factor. The integration of a new system and new technology will be better accepted by the society of a fast growing city and the demand on the GLT line will grow accordingly.
- **GLT-track-non guided mode**
This indicator gives an assessment of the track used by GLT in a non-guided mode. Ideally the GLT will not be confronted with any congestion problem in this section, neither with obstacles as narrow roads, steep gradient and short curves.
- **GLT-track-guided mode**
This indicator assesses the opportunity to provide a section of GLT track in a guided mode.
- **Integration in public transport system in short term**
This indicator assesses the opportunity and the acceptance of the integration of the GLT in the public transport system in short term.
- **Integration in public transport system in long term**
This indicator assesses the opportunity and the acceptance of the integration of the GLT in the public transport system in long term (5 - 10 years)
- **Demand**
This indicator gives an assessment of the potential passenger demand on the new GLT line.
- **Social acceptance**
It is a fact that the integration of a GLT system into a public transport system, means that several small and medium size buses will be on GLT system. This has an impact on the employment. It is expected that in fast growing cities or cities with heavy congestion problems, the implementation of the GLT system will be more easily accepted by the population.

- **Urbanistic integration**

The GLT being the backbone of a public transport system will also determine the view of the city. In fact the GLT should become a city representative to attract possible investors and tourists. This indicator gives an impression of the interest of the GLT track for the city.

4. RESULTS AND DISCUSSION

The table 2 below gives a qualitative assessment of all indicators for all cities. The assessment ranks between "0" (no added value) and "+++" (very high added value).

Table 2. The result of indicators comparison

Indicators	Batam	Medan	Palem- bang	Den- pasar	Manado	Ujung Pandang	Sema- rang
Population	+	0	++	+	+	++	++
Socio-economic growth rate	+++	+	++	+	++	++	+
GLT track non-guided mode	+++	0	+++	0	+	++	++
GLT track guided mode	+++	+	+++	+	++	+++	+
Integration public transport short term	++	+	++	++	0	++	0
Integration public transport long term	+++	0	++	++	++	++	++
Demand short term	0	+++	+++	+	+	++	++
Demand long term	++	+++	+++	++	++	+++	++
Social acceptance	+++	++	+	+	++	++	+
Urbanistic integration	+++	+	+++	+	+++	+++	++

It is evident when looking at the total result of assessment, the evaluation crosses do not have to be added up to be able to rank the cities. A ponderation of the qualitative indicators is needed, because the global evaluation cannot be done in a mathematical way. Therefore the results for each city are further discussed in the next paragraph below.

- **Batam**

As development area Batam is an ideal candidate. The rapid growth of Batam will end up with congested roads in the near future. Not integrating a public transport system as a structural element of the network at this stage would be a lost opportunity. The implementation of a GLT in guided mode in Batam Centre can prevent congestion in the future. Nevertheless, the public transport demand is actually quite low at the present time, which will have a negative impact on the exploitation costs in the starting-up phase.

- **Medan**

With more than 2 million inhabitants and characterised by heavy congestion problems, implementing the GLT system in Medan wouldn't be enough to solve the problems.

- **Palembang**

Palembang has reached the point that the public transport system must be extended with a high capacity system. The roads on the proposed track Pusri - centre - Plaju are being renewed and enlarged. On the central axis there is a very good opportunity for

implementing a guided mode lane for GLT. Palembang is certainly a very good candidate.

- **Denpasar**

Due to the narrow streets it is impossible to find an interesting track for both tourists and inhabitants. The population of Denpasar is also too low to justify a GLT implementation in the short time.

- **Manado**

Manado has a very extended public transport system with still some spare capacity. The city is growing quite fast and has a lot of tourist opportunities. The present population is too low to justify a GLT implementation. Nevertheless if the coastal road will be extended to the North (new tourist resort) in the future, a GLT integration could be considered.

- **Ujung Pandang**

Ujung Pandang has also reached the point that the public that the public transport system must be extended with a high capacity system. Nevertheless, it will be very difficult to give the GLT the necessary priority on the main axis. An ideal solution would be to integrate the GLT in guided mode in the new road from ferry port to new project development and further to the South bus terminal. If the project can get an engagement from the city about this concept, then there is a very nice project for GLT implementation.

- **Semarang**

The situation of Semarang related to public transport can be compared with Palembang and Ujung Pandang. Nevertheless, the authorities of Semarang have recently decided to replace the small and medium-size buses, by large buses. Therefore there is no possibility left to consider a GLT implementation in short term.

Based on the comparative assessment above, it can be summarised that the most potential candidates for GLT implementation in Indonesia are Batam, Palembang and Ujung Pandang. Further study are then needed in order to determine the more detailed step for implementing GLT system in those cities.

5. GLT SYSTEM FEASIBILITY STUDY IN BATAM

Batam Island, 416 square kilometres of bonded area is one of the most attractive places in Indonesia for industrial, marshalling, trade and tourist enterprises. The population has grown from 600 inhabitants in 1973 to 200.000 in 1996, with a prospect of 700.000 in 2006. Batam's location is very strategic on the key international shipping routes and very close (20 km) to Singapore. The Indonesian Government has set up a Batam industrial development plan which is executed by the Batam industrial development authority.

For the purpose of implementing GLT system in Batam, the feasibility study of GLT system has been undertaken (Bombarider EURORAIL and BPP Teknologi, 1996), which covers:

- Definiton of future track for GLT (for the year 2006)

- Definition of sections (guided-non guided, diesel-electrical propulsion, separate lane - bus mode)
- Locations of stops and terminals
- Location of workshops
- Estimation of expected income
- Estimation of implementation and operation cost
- Scenarios for financing of project

A transportation model was built using EMME/2 transportation planning software package (Inro Consultant Inc, 1992) in order to determine the demand and the expected income of the people using GLT system in the year 2006. The transportation model which based on the master plan of Batam has indicated that in 2006 the line Sekupang - Batam Centre is regarded as the best route for the implementation of GLT system. Figure 2 represents the GLT line Sekupang - Batam Centre. There will be 28 vehicles needed to guarantee the service on the line Sekupang - Batam Centre with a frequency of 2 minutes on the section Batam ferry port - Intersection jam baloi and a frequency of 15 minutes of the section Intersecton jam baloi - Sekupang ferry port.

In the current situation there is no need to implement a GLT system in Batam because the traffic flows are very low. Therefore two alternatives were proposed:

- Alternative 1 : GLT operational in 2001 on half of the capacity of 2006
- Alternative 2 : GLT operational in 2001 on full capacity

The first alternative means that 12 vehicles are bought for the first stage, 16 are bought for full capacity operation in 2006. The second alternative means that all 28 vehicles become operational in 2001.

The transportation model also forecast the number of trips per GLT. It was assumed a two zone system existing of the Batam Centre (inclusive Jam Baloi) and the zone Sekupang - Tiban (also inclusive Jam Baloi). The cost of a trip within one zone was assumed Rp. 1000 and a trip of two zones was assumed Rp. 2000 (based on 1996 price).

For both alternatives some financial scenarios have been done. The objective of the simulations is:

- to have an idea of the return on investment (ROI) based on the available financial element.
- to have an idea about the cash flow
- to get a feeling about the sensitivity of the ROI to the revenue rate and capital grants.

In the table 3 below the simulation results are represented.

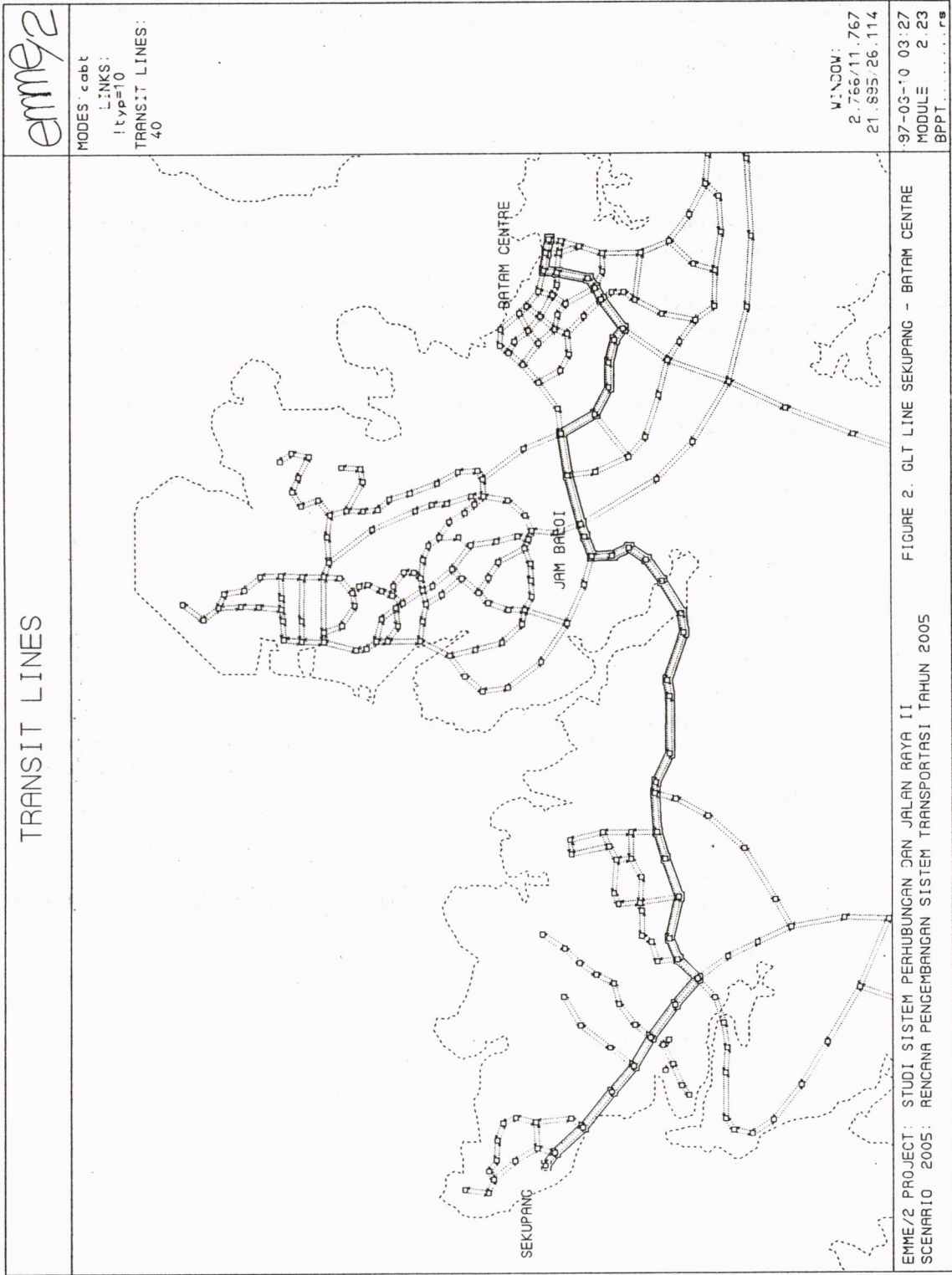


Table 3. Result of Financial Simulation for Alternative 1 and 2

	Revenue Rate	Capital Grant	ROI	Positive Cash Flow	Positive Cumulative Cash Flow
Alternative 1	1.0	0	- 21 %	2011	2019
	1.4	0	64 %	2001	2001
	1.0	20 %	12 %	2012	2016
	1.1	20 %	36 %	2011	2012
	1.2	20 %	59 %	2001	2001
Alternative 2	1.0	0	- 36 %	2011	2019
	1.4	0	29 %	2007	2012
	1.0	20 %	- 21 %	2010	2017
	1.1	20 %	0 %	2009	2014
	1.2	20 %	20 %	2007	2013

Based on the simulation it can be concluded that the ROI is very sensitive to the revenues which are an outcome of the transportation model. This model has a basis from the master plan of Batam with projection year 2006.

6. CONCLUSIONS

Based on the result of the comparative assessment it can be concluded that the most potential candidates for the GLT implementation in middle cities in Indonesia were Palembang and Ujung Pandang. In addition to those two cities, Batam Island has been chosen as a pilot project for the implementation of GLT system in Indonesia.

The feasibility study for GLT implementation in Batam Island has also been undertaken. The result of the transportation model indicated that the corridor Sekupang - Jam Balo - Batam Centre was regarded as the best route for the GLT system. The result of financial simulation showed that implementing GLT system in 2001 on half of the capacity of 2006 was better than implementing GLT system in 2001 on full capacity.

The similar feasibility study should also be undertaken for Ujung Pandang and Palembang to determine the GLT route, stops and terminal location, depo location and also scenarios for financing GLT project.

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