Improving Transportation Connectivity in Cikarang Area with Rail Based Infrastructure

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ABSTRACT

Rapid growth of economic potentials in the Cikarang area ranging from the economic, trade, service and industrial sectors are supported by settlements in various scales, it shall be accordance with improvement of transportation connectivity in the Cikarang area. The government has planned the construction of rail-based transportation infrastructure in Cikarang area due to road exceeded load capacity. To overcome the magnitude of potential problems that can be generated from the increased volume of vehicles, population growth and efforts to provide alternative transportation modes for Cikarang and surrounding areas, it is necessary to study Transportation Connectivity Improvement on Cikarang Area with Rail-Based Infrastructure. This research applied a combination of quantitative and qualitative approaches through questionnaires, action research and case studies on the development of integrated connectivity transportation planning in the area. The result show urgency of rail-based infrastructure development for the Jakarta buffer zone to improve the mobility and connectivity of economic activities.

Keywords

Cikarang Area, Connectivity, Potential, Rail Infrastructure, Transportation

1. INTRODUCTION

Development of urban areas of Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) are increasingly advanced and become an area of urban agglomeration, resulting in social interaction and daily activities are not limited by borders. Currently, the development of Jakarta's urban areas and its buffer zones is increasing rapidly. This is evident from Jakarta Transportation Statistics data of 2015 which shows the rapid number of commuter in Jabodetabek area of 3,566,178 people. The number consists of 2,429,751 people conducting activities in the area of DKI Jakarta, 1,067,762 people in Bodetabek and 68,665 people outside Jabodetabek. Jabodetabek is a fast growing Indonesian territory with a population of 28 million.

Thus Bekasi area is the region with the highest daily pattern for Jabodetabek. One of the buffer areas in Bekasi area that is experiencing rapid growth is Cikarang. As part of Bekasi Regency, Cikarang is included in Development Zone II which has various economic potentials ranging from trade, services and industries supported by settlements at various scales. With the economic activities of the community not only concentrated on the Cikarang area but also other areas such as Jakarta, Bogor and Tangerang caused the gap of community needs for a reliable transportation system.

Currently, access to and from Cikarang is mainly supported by road infrastructure, especially toll roads. This causes the number of private vehicles within the city is large enough. Recorded vehicle growth rate of 12% per year, but the growth of roads was less than 1% per year. The volume-per-capacity ratio data for the toll roads around Cikarang shows the high number of passenger units per hour. This condition leads to the need for transportation alternatives i.e. rail-based infrastructure to increase the connectivity of Cikarang and surrounding areas and reduce the traffic load.

However, rail-based transportation in Jabodetabek area has a number of issues, including: Limitations on the number of railway facilities; Reliability and capacity of railway infrastructure (track, signaling, telecommunication); The overlap pattern of rail operations between long-distance train travel and commuter train

travel; Limited capacity of railway facilities (depot); The station facilities are still minimal and less convenient; Limited access from/ to the station; As well as limited investment in the rail business. The government has so far made efforts to overcome the limitations of rail-based transportation services, among others by improving railway infrastructure and facilities supported by creative funding with the Government & Private Partnership financing scheme in overcoming the limitations in urban railway investment issues.

1.1 Efforts to Increase Movement Mode

Nowadays, the role of railway mode especially in Jabodetabek is still very low. Therefore, efforts are needed to encourage the change of modes from road to rail transport by applying service and implementing traffic restriction policies. The purpose of applying feeder services is to minimize the amount of road transport, which further reduces total travel time and travel expenses. Similarly, the target of providing residential parking facilities is to reduce travel time (and travel fare) to the railway station.

The feeder service network needs to be integrated with the rail network. The service may be considered an extension of the rail network, which extends the scope of the rail service so that the entire network may include the origin and destination points of travel. The railway mode that has the largest capacity of the system will serve as the backbone of the integrated freight system, and lower-capacity road transport will serve as a feeder for rail services.

Ideally the integration is not only applied to network systems but also including tariffs. With the integrated tariff, travel costs are not dependent on the amount of intermodal shifts, but only depends on mileage.

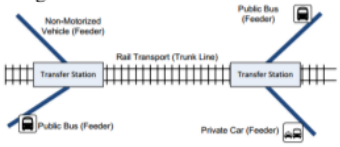

Figure 1 Feeder Service Concept
(Reference: Hatmodjo, 2014)

In order to have efficiently service in rail transport, an integrated transfer station is required in order to move from railway to roadway and vice versa becomes easier. The better the transport system, the less time and cost it will take during the transfer process. Integration between rail services and private transports can be provided by applying residential parking facilities. Private transit users can park their vehicles in the parking lot around the station and then continue the journey using the train service. To attract more private transport users, parking fees can be integrated with train fares.

1.2 Quality of Railway Services

Quality of service is one of the important elements in service organizations. This is caused by the quality of service is one tool used to measure the performance of service organizations (Hope and Muhlemann, 1998). Quality can be defined as conformity between standards and specifications (Crosby, 1979) or "suitability in use" (Juran, 1999). In the public sector, quality is more associated with service, this is in line with the definition from Logothetis (1992) that quality is the fulfillment of the needs and expectations of customers or clients and then improve them on an ongoing basis.

Improvement in the railway sector is not only about the development and improvement of physical infrastructure, but the quality of service factors, especially the timeliness of travel is another very important thing (Hidayat, 2011). Timeliness and reliability of public transport, especially rail is an important component in service quality to achieve passenger satisfaction (Goverde, 2005).

The Association of European Railways Organization of Intelligent Integration of Railway System (IntegRail, 2008), incorporated the timeliness indicator as one of the Key Performance Indicators (KPI) in rail operations. IntegRail explains the KPI branches for each rail area, which includes rolling stock, infrastructure, operation management, and traffic management.

Improving the quality of public services can be implemented through two things, namely the improvement of government functions through the shifting of public service paradigm from the old public administration model to the new public management model and finally to the new public service) As well as increased community control as a direct user of rail transport.

2. METHODOLOGY

This research focuses on the argumentation of infrastructure development, as well as recommendations of the concept of rail-based infrastructure connectivity. This study begins by setting goals and objectives as study targets. Furthermore, a review of literature/ literature review by reviewing legislation, comprehensive evaluation for previous studies related to the development of rail-based infrastructure in the Cikarang area, and benchmarking associated with inter-mode and multimoda integration. Then identified the data gap with the standard achievement that should happen / applied. On the basis of the gap, the formulation of the problem and the determination of the strategy of completion of this study.

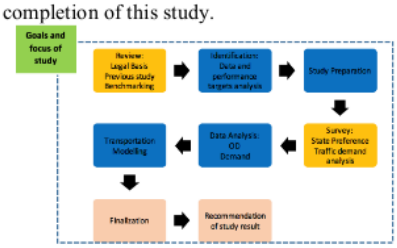

Figure 2 Research Flow Diagram

The approach taken in this study for each objective is described as: reviewing the implementation of trains in Jakarta, Bogor, Depok and Bekasi areas; To study potential demand and travel movement seen from the existing condition and potential and development plan of Cikarang region; And proposed a pattern of light rail integration based on service networks, infrastructure and service nodes. Implementation of analysis of patterns of movement of people and goods inter and intra zones within the review area reviewed and projections (within the next 20-30 years) is done to meet the travel demand analysis. The method in this trip demand analysis is carried out by the transport-four stages modeling method.

Theoretically, the four strages transport modeling method is applied to calibrate the model connecting the pattern (size, distribution, mode and route usage) of travel demand with the characteristics of the population in the region (population, GRDP, production, etc) to obtain a description of Performance (cost, time, environmental impact) of the current and future transport network in conditions with or without changes in the transport network (do-nothing and do-something).

The prediction of the potential and the pattern of movement of passenger transport and the transport of logistic goods (non-

negotiable goods) shall be based on data from the survey of ATTN (Origin of National Transportation Destination) conducted by Balitbanghub Year 2011 (or hereinafter referred to as ATTN 2011).

3. IMPLEMENTING RAILBASED TRANSPORTATION IN CIKARANG AREA

3.1 Review of General Plan of Jabodetabek Railway Network 2014-2030

In the General Plan of Railways Network of Jabodetabek Area 2014-2030 there are several plans of rail-based transportation routes that connect several central of economic and social activities. Therefore, the Directorate General of Railways, Ministry of Transportation has undertaken to establish several routes for increasing transportation capacity in Jabodetabek as outlined in Ministerial Regulation No. 54 of 2013 on general plan of mass transportation network in Jabodetabek urban area as shown below.

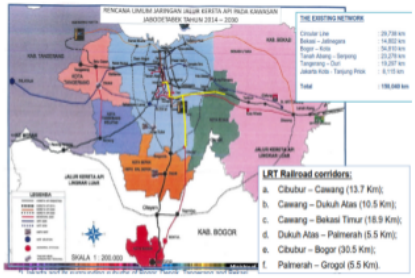

Figure 3 Jabodetabek Railway Service
(Reference: PM 54 of 2013 on General Plan of Mass Transport Network in Jabodetabek Urban Area)

3.2 Review of Implementation of Rail Based Transportation System in Cikarang

3.2.1 LRT Jabodetabek Development Plan

President Joko Widodo has signed two Presidential Regulations to implement the construction of this LRT on September 2, 2015, including:

a. Presidential Regulation 98/2015 on Accelerated Light Truck/ Light Rail Transit in Jakarta, Bogor, Depok and Bekasi
b. Presidential Regulation No. 99/2015 on Acceleration of Public Railway Implementation in the Provincial Region of the Capital Region of Jakarta

At the Presidential Regulation, PT Adhi Karya is appointed as the executor of the construction of facilities (lanes including the construction of elevated lines, stations and operating facilities). The project will be implemented by PT Adhi Karya (Persero) Tbk consisting of six routes: Cawang - Cibubur, Cawang - Kuningan - Dukuh Atas, Cawang - East Bekasi, Dukuh Atas - Palmerah Senayan, Cibubur - Bogor and Palmerah - Grogol. In the same Presidential Regulation mentioned:

> *"In addition to the Cross Service as referred to in paragraph (2), the Government may determine the other Cross Service as stipulated by the Regulation of the Minister of Communications"*

This enables other cross-service proposals to be intended as a form of proposal to the government other than the route already given to the Presidential Regulation.

Figure 4 LRT Jabodetabek Service Network
(Reference: Masterplan of National Railways, 2006)

In implementing the LRT system in Indonesia there are several considerations in the planning and implementation, among others: required Spatial Planning Town; Less investment is required; And require inter-modal integration.

3.2.2 Double Double Track (DDT)

The 34,14 km Double-Double Track (DDT) project of Manggarai-Cikarang is a following scheme to Commuter Line train operation plan up to Cikarang Station. Development of DDT is divided into four work packages. Package A (Manggarai-Jatinegara) worth Rp 3.440 trillion, Package B2 (1) (Jatinegara-Bekasi) Rp 900 billion, Package B2 (2) (Jatinegara - Bekasi) Rp 260 billion and Paket B1 (BekasiCikarang) worth Rp 1.121 trillion.

The main purpose of this development is to make the Commuter Line train trip to be independent, not hampering long distance train travel. Double track development for the Manggarai-Cikarang line is estimated to be completed by early 2018.

3.2.3 Mass Rapid Transit (MRT)

The project is divided into three phases: the first North - South corridor (Lebak Bulus - HI) which will be operational by 2017, the second - phase North - South corridor (201 HI - Kampung Bandan) and the East - West corridor (Bundaran HI - Kampung Bandan) Cikarang - Balaraja) in 2027.

In the first phase of North-South corridor, there are 13 stations to be built, namely 7 flyover stations with 9.2 km long corridor consisting of Lebak Bulus, Fatmawati, Cipete Raya, Haji Nawi, Blok A, Blok M and Sisingamangaraja, and 6 Underground station along 6 km long corridor consisting of Bundaran Senayan, Istora, Bendungan Hilir, Setiabudi, Dukuh Atas, and Bundaran HI. Between Sisingamangaraja Station and Bundaran Senayan Station there will be displacement of rail position from overpass construction to underground construction. The depot for the system is located at Lebak Bulus station.

4. RESULT AND DISCUSION

4.1 Characteristics of Movement Patterns and Travel Demand

The pattern of movement in the study area covering 2 provinces of DKI Jakarta and West Java became the basis for determining the characteristics of the movement pattern that will determine the magnitude of the potential for movement/ demand related to the feasibility study of the construction of this Light Rail/ LRT line. The pattern of passenger movement is presented based on the district / city, so that the zone base used is the zone of regency/ municipality administration in the two provinces.

Zone Region	No.	Zone	Remarks
Internal Zone	1	Central Jakarta	Include All Region of Central Jakarta
	2	North Jakarta	Include All Region of North Jakarta
	3	West Jakarta	Include All Region of West Jakarta
	4	South Jakarta Selatan	Include All Region of North Jakarta
	5	East Jakarta	Include All Region of East Jakarta
	6	Bogor	Include All Region of Bogor District
	7	Bekasi	Include All Region of Bekasi District
	8	City of Bekasi	Include All Region City of Bekasi
	9	City of Depok	Include All Region City of Depok
External Zone	1	Tangerang Raya	Include All Region of Tangerang District, City of Tangerang and South Tangerang
	2	Middle part of West Java	Include All Region of Karawang District and near by area

Figure 5 Determination of Zones of Study Areas

Based on data from the Origin of National Transportation Destination 2011 that has been projected to the reference year of 2016, the description for the movement of passengers in Cikarang region as follows:

a. Total passanger movement on 2016 is approaching 669,82 million people/year.
b. 33,62 % (225,20 million people/year) are ekstemal-intemal movement around study area.
c. Internal movement within the study area can be estimated based on the 2014 projected of 454.23 million people/ year.
d. Passanger potential demand for rail transportation user is expected to come from the internal area (Central Jakarta, North Jakarta, West Jakarta, South Jakarta, East Jakarta, Bogor, Bekasi, Bogor City, Bekasi City, Depok City and some other districts).
e. For external areas, the potential for demand comes from the movement from west to east, and on the contrary, this is certainly due to the strategic position of the study location which is the center of national activities.
f. In this condition, competitors come from road and air mode, however, the condition of train competitiveness especially for passenger transportation will be focused on competitive tariff so that it will be able to improve the competitiveness of the train compared to other competitors.

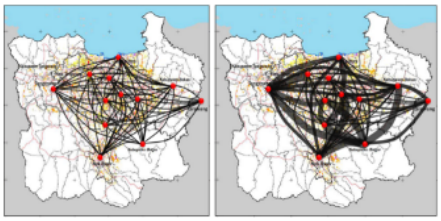

Figure 6 *Desire line* Passanger Movement 2016 (left) and 2046 (right)

Based on the projection of the passenger movement of the study area on the 2016 LRT plan, it can be seen the spreading of the movements of movements in the Successful Destination Matrix for 2026, 2036 and 2046, as well as the trend and desireline of passenger movement until 2046.

4.2 Potential of Passenger of Railway Transportatation in Cikarang Region

Analysis of the potential for movement in the study area in Cikarang and its surrounding area is done based on the result of field survey conducted through interview and RSI survey at several representative points. From the survey results, it can be estimated that the probability of the potential shifting of modes of private transportation both motor and car reaches ± 80% range. This figure shows an optimistic indication of the implementation of LRT in the study area. However, realization will be possible if the implementation policy is supported by the concept of connectivity and ease of achievement for LRT users. On the other hand, the development potential of LRT in JABODETABEK area is time to be done, considering the enthusiasm of the use of LRT transport is currently in great demand in the region where it is recorded that up to ± 35% of total movement is LRT users.

When correlated to the aspect of the level of socio-economic growth of the region that will affect the magnitude of the movement of the region, it can be estimated the movement of the Cikarang and around 1.7 million people/ year in 2016. The following estimates projected growth of Train / LRT users in Cikarang and surrounding areas In the table below.

Table 1 Projection of Passenger Movement of Study Areas

Passengers Demand	
Year	**Passengers**
2016	1.702.352
2021	2.030.610
2026	2.433.196
2031	2.915.597
2036	3.493.639
2041	4.186.282
2046	5.016.248

4.3 Mode Choice

The analytical step in predicting the railway mode utilization rate in the corridor is based on modal choice preference by using representative model of modal split model (representing the real behavior of potential users). Modeling mode model used is binary logit where to calibrate its utility function used data of survey result of passenger transport of private car, motorcycle, and bus users.

4.3.1 Rail Transporation vs Private Car

The equation of utility rail vs. private vehicle is the result of linear regression to the data of the interview survey results to the travelers who have been using the private vehicle. The quality of the results of the model is shown by R2 value of about 0.047658363.

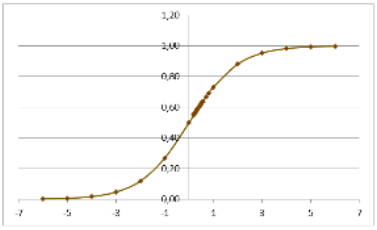

Figure 7 Train Vs Private Car

From the figure, the concentration point is concentrated on the probability 55 to 70%, this indicates that the probability of switching modes of private car users to rail mode is in the range of 55 s / d 70%. The magnitude of probability of switching between modes is obtained from the binary logit formulation based on the difference in cost and time of both modes. Illustration of the use of equations is as follows, cost difference

between car user and train Rp. 20,000 and speed difference between car users and train is 10 km / hour. Based on the existing equation, the probability of moving the car mode to train is 13.84%. From the formula obtained and examples of the above cases it is noteworthy that the magnitude of the cost difference (Δ COST) gives a greater probability of displacement.

4.3.2 Rail Transporation vs Motorcycle

The equation of utility train vs motorcycles is the result of linear regression to the data of survey interview result to the passenger service users who have been using motorcycle. The quality of the results of the model is shown by the value of R2 about 0.007623983.

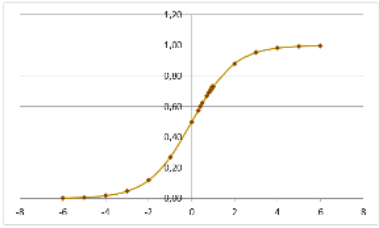

Figure 8 Train Vs Motorcycle

4.3.3 Rail Transportation vs Public Vehicle

The utility equation of train or in this context LRT vs. public vehicle is the result of linear regression to the result data of the interview survey to the passenger service users who have been using the bus. The quality of the results of the model is shown by the value of R2 around 0.2679.

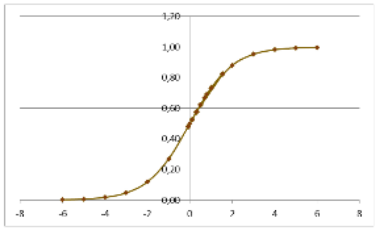

Figure 9 Train Vs Public Vehicle

5. CONCLUSION

After reviewing the relevant regulation framework, the improvement of transportation connectivity in Cikarang area with rail-based infrastructure already has a legal aspect covering it. Where Cikarang is already an area targeted as part of urban railway planning, which is summarized in 2 PM. 54/2013 on the General Plan of Mass Transport Network in Urban Area Jakarta, Bogor, Depok, Tangerang and Bekasi (Jabodetabek) and Presidential Regulation No. 98/2015 on Accelerated Light Rail Transit (LRT) implementation integrated in Jakarta, Bogor , Depok and Bekasi.

Then, the results of demand analysis on the movement that occurred in the study area and then projected to the next 30 years, there are a number of 5,016,248 passengers who can share the LRT plan. This is supported by the probability data of the potential of shifting modes of private transport both motor and car to reach ± 80% range, this is certainly an optimistic indication of the implementation of Train / LRT in the study area, given the enthusiasm of the use of train is currently in great demand in the region where it is recorded that up to ± 35% of the total movement is a train user. This may be achieved if the implementation policy is supported by the concept of connectivity and ease of achievement for train users.

Therefore, the implementation of LRT Integrated in the areas of Jakarta, Bogor, Depok and Bekasi based on the identification of service networks, infrastructure and service nodes, it is necessary to formulate alternative routes and financing simulations.

6. ACKNOWLEDGMENTS

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