

Railway Transportation System as the Integrator of Intermodal Transport in Jabodetabek Area, Indonesia

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Abstract: -The aim of this research is to explore the issue on the railway integration in Indonesia and particularly in Jakarta; how to enhance the implementation of Light Rail Transit, Mass Rapid Transit, and bus as well as the plan to use Tram. The problems in the integration of railway transportation in Jabodetabek have been identified, namely; the transportation problems in Jakarta with the growth rate of road not equal to the increasing number of motor vehicles, railway transportation problems, the unintegrated use of Commuter Line, Light Rail Transit, Mass Rapid Transit, Airport Train and Transjakarta bus. This research uses qualitative explorative method, with the data obtained from observation, literature study and in-depth interview with informants or interviewees from the government as the regulator, State-Owned Enterprises as operator and train industry performed in 2018. The result of this research needs railway transportation system as the integrator of intermodal transport in Jabodetabek area. Transit Oriented Development (TOD) can improve the accessibility by providing a relatively high level of transportation connection. To anticipate terrible traffic jam it needs to develop an integrated mass transportation mode.

Keywords:- *Intermodal; Traffic Jam; Railway Integration; Transit Oriented Development*

I. INTRODUCTION

In particular, the strategic problems of intermodal transport in Jakarta, Indonesia are: (1) Weak law enforcement, (2) Low cross-sectoral coordination, including inefficient management, (3) Pressure from global logistic competition which weaken the strength of national logistic service providers, (4) Insufficient infrastructure support, (5) Poor intermodal transport and interconnection among port infrastructures, warehousing railway and transportation, and (7) Low utilization of information and communication technologies. The public transportation system at regional and local levels are complicated and intrinsically related to land use and long term regional ambition [1].

The problems of the integration of railway transportation in Jabodetabek have been identified, namely; transportation problem in Jakarta with the road growth rate not equal to the increasing number of motor vehicles, railway transportation problem, the unintegrated use of

Commuter Line, LRT, MRT, Airport train and Transjakarta bus. In general, the government has targeted a long-term development of railway subsector with the following programs; (1) National railway network in 2030 as long as 10,524 kilometers in the islands of Jawa-Bali, Sumatera, Kalimantan, Sulawesi and Papua, including urban railway network as long as 3,755 kilometers, (2) Facilities of passenger transport with minimum number of locomotives as many as 2,839 units, passenger train as many as 34,178 units, and (3) Cargo transport facilities with minimum number of locomotives as many as 2,475 units and railway coach as many as 48,364 units [2].

The general idea of sustainable urban transportation explains that additional “services” provided by new transportation infrastructures must be paid by those who directly take the benefit of it, namely land/property owners surrounding. The development area [3]. Today, according to [4] railway industry is in the position that can take advantage of the opportunities created through the Internet of Things Industry and that enable the communication technology under the paradigm of Train Internet. The research in Shanghai, China [5] indicates that although the infrastructures are excellent but the integration level is still low, whereas the potential benefit of the integration can be very big.

The objectives of sustainable urban transportation can be pursued through; (1) efficiency that can enhance mobility and reduce traffic jam, (2) environment so as to reduce the impact of traffic jam, and (3) equality and justice which are expected to reduce poverty level. A railway observer from Masyarakat Perkeretaapian Indonesia (MASKA) [6] explains that Jakarta has been “crowned” as the city with the worst traffic in the world according to Castrol's Stop-Start Index, having population as many as 31 million, 24.9 million motor vehicles and number of travel in Jabodetabek using the data of 2015 as many as 47.5 million/day with no additional road length in Jakarta in the period of 2010-2014.

The route of public transportation mode according a railway observer from PT Industri Kereta Api (INKA) [7] is still focused on the areas of economic and commercial centers (Senayan, Sudirman, Thamrin) and reaches only a little part of Jakarta suburban areas. INKA as a strategic industry should master the railway technology together with the development to reduce the dependence on foreign countries and become a company that drives national industrial growth. Improvement of urban traffic system,

especially in big cities/metropolitan cities like Jakarta, must be done in an integrated and holistic way.

Integration between land use planning and transportation system is needed [8]. The shift of paradigm and mindset of central and local government from the transportation policy that support the use of private cars to the policy supporting public transportation, as well as local government's courage and commitment. Any movement integration, for example a little cargo, will potentially increase the volume intermodal transport, and its impact will be able to enhance the movement of transportation mode from road to train [9]. It is very important that the strategy for inter-modal segregation of road, inter-modal train and inter-modal inland waterways transportation are reviewed from several economic and environment policies. Some researches on intermodal transport in Jabodetabek, as explained another researcher [10], indicate that inter-modal integration like in Universitas Indonesia Station is still considered not good due to the unavailability of other transportation modes and access.

Whereas in West Sumatera, researcher explains that the transportation mode planning which is operationally integrated with other public transportation modes will run well [11]. Another railway observer, Djoko Setijowarno, explains that the physical integration between what so called electric train (KRL) station of Sudirman and the bus halt of Transjakarta in Dukuh Atas is too far [12]. This fact makes passengers choose to continue their trip using online taxibike called *ojek*. If the physical integration is established, passengers should then get an easy access to other public transportation modes.

To anticipate terrible traffic jam it needs an integrated development of mass transportation mode KRL Commuter to prevent the worry about "Stagnant Transportation" from occurring [13]. Integrated researches have ever been done by some researcher [14] and [15] by introducing the technology of Global Navigation Satellite Systems (GNSS). Another researcher explains that although integrated transportation can be commercially and economically advantageous, a conducive government policy is needed to generate a good investment climate [16]. A similar research by [11] states that a good planning is to adjust the travel time and travel cost, to adjust integrated transportation mode with public transportation mode. Special for the integration with port container terminal, container terminal and train schedule must be flexible and can contribute to the improvement of the integrated container transportation performance (Hu, et al., 2019).

Research in China by [18] using Delphi method concludes that such indicators as synergy in structure, transportation, organization, management, and information have contributed much to the synergy level of railway transportation system. Today it can be said that the approach to the integration of airport train is still limited and does not have national coordination necessary for taking advantage of intermodal transport of train to airport [19]. Another researcher [20] in Taiwan propose a strategy

to integrate relevant transportation which improves the unlimited transportation service quality in order to achieve the objectives of developing a green transportation system.

The optimized scheme of integrated service and frequency coming from the model can significantly reduce the total cost [21]. Another finding from [22] explains that transit train will be able to guide population suburbanization in a short time and the formulation from various employee activity centers in a long time. Transit Oriented Development (TOD) is the concept of area development within and surrounding the transit node to have added value which emphasizes the integration of among mass public transportation networks, and between mass public transportation network and non-motor transportation mode network, as well as emphasizes the reduction of motor vehicles accompanied with mixed-and-crowded area development with the intensity of space utilization from fair up to high level.

Theoretically, according to [23], TOD can enhance the accessibility by providing the relatively high level of transport connection and the use of high-density land, use of mixed-land, bicycling and pedestrian-friendly around the transit station. TOD is usually defined as the high-density mixed area (housing and commercial complexes) in the walking distance from public transportation station having high capacity (usually in the buffer area of 800 meters) [24]. TOD has become a promising concept to develop land use and transportation integration so as to build a more sustainable society [25].

II. RESEARCH METHOD

This research uses qualitative explorative method and descriptive explanation. This study takes some interviewees as the source of research. It is a new study and there are still few researches on it. Data is based on observation, literature study and in-depth interviews with some interviewees from the government as regulator, from state owned enterprises as operators and from train industry, observers or railway organization in 2018.

III. RESULTS AND DISCUSSION

A. Selection of Railway Transportation Mode Technology

The scheme of selecting urban mass transportation mode technology is based on the number of daily passengers per kilometer one way, distance and passenger density. In-depth interview with interviewee from railway organization, train researcher [3], explains that for the distance of up to 10 km we can use buses, with the density of up to 4,000 passengers. For the distance of up to 10 km with density of 10,000 passengers we can use New Urban Transit Systems, such as Monorail, High Speed Surface Transport (HSST). While for the distance of more than 10 km with density of 60,000 passengers we can use Subway, Urban Railways, LRT, or Sub-urban Railways.

To formulate the implementation of mass public transportation system development, according to [3], policy and target must be made appropriately, such as the area to be served, level of compensation, level of accessibility, common feature of service, so that the intention and the use of resources can be achieved. On the operational level, it is necessary to formulate how to develop appropriate facilities to assure the delivery system, how service can be delivered efficiently; in term of management, vehicle maintenance, personnel management and fleet renewal. Selecting the most appropriate transportation model, one of which is through the government policy, can also be done using the approach of Analytic Hierarchy Process or AHP [8].

B. Integration of Railway Network

The challenges of railway development with several activities according to the Director General of Railway, [2] are; (1) synchronization of development policy among agencies or between central government and local government, (2) people urbanization with the high risk of social impact at the time of development, (3) equal distribution of infrastructure development, (4) government's limited funding capability, (5) availability of expert human resources, and (6) capability of industry to face the demand for development. The challenges after the development (operation stage) along with government program are; (1) maintenance and supervision (including threat of vandalism), (2) adaptiveness to the progress (including technology) and (3) inter-modal integration.

The integration program between railway network and airport covers the following development stages: preparation, development of existing infrastructure & development of new infrastructure. The integration model on the urban train development program is interrelated among; (1) Institutional Integration: Arrangement/contract among the stakeholders in fulfill the commitment to transportation service providers, (2) Operational Integration: Public transportation coordination and planning by minimizing the travel distance and duration for the sake of smooth and comfortable transportation, and (3) Physical integration, to accommodate passenger transit comfortably in the movement from one road transportation to another (Miller, 2004 in Perhubungan, 2018).

The integration of public transportation mode in Jabodetabek consists of several routes of LRT, MRT, Airport train, KCIC, Commuter Line, and BRT [2]. The government also develops some supporting programs, such as; (1) the construction of Park and Ride facilities at railway stations, (2) the development of residential and business areas integrated with public transportation network (Transit Oriented Development), (3) the development of feeder transportation toward railway stations, (4) the arrangement of the area around the railway stations as well as the area along the rail, and (5) the development of flyover/underpass to handle level crossings.

C. Transit Oriented Development (TOD) Program

In order to overcome the problem of modern urbanization, transit oriented development (TOD) seems to be the solution that has been well thought out for modern society. TOD or the same concept like transit village, transit-friendly design, and the development that support transit having the same attributes which have been understood in the way that encourages the use of public transportation and creates pedestrian-friendly environment [26]. Some government policies related to the strategy of optimizing the development usage according to [2] are; (1) the implementation of rules related to standard minimum service, (2) support to the local government policy on transportation (feeder transportation routes), (3) subsidy for effective transportation, (4) the realization of conducive investment climate, (5) policy on information technology-based standard service, (6) synchronization of cross-sector strategic plan, and (7) the implementation of societal education program.

The programs that need to be developed are; (1) the enhancement of inter-modal transfer facilities development (passenger/cargo), (2) the development of railway infrastructure based on area development (TOD), and (3) the development of green transportation facilities. It is necessary to implement the combination of corridor system and circulator system [8]. Corridor system is the main route with end to end in its nature (or I may be circular but still in the main line), whereas circulator system is the circular route needed as the feeder for corridor system, which can attract passengers living in housing complexes.

TOD Program at Dukuh Atas Station comprises; (1) developing the interconnection of mass transportation network in Jabodetabek, (2) developing high-density urban area around railway station with the concept of TOD which can reduce the distance among office complex, plaza/mall and residential area, and (3) promoting the use of mass public transportation by facilitating the access to use mass public transportation. Transit Oriented Development (TOD) includes; Interchange point in Manggarai, Dukuh Atas (priority), Kampung Bandan, Senen and Blok M, and High density developed urban areas in Kemayoran and Kelapa Gading [2]. TOD has been widely accepted in the last several years as an important policy on urban development (Xu, et al.,2017). The result of research shows that the second and third class cities in China will have more potential to implement TOD rather than main class cities in the next five years. The research by [28] indicates that some areas of metro Jakarta are very suitable for TOD.

D. Integration of Light Rail Transit (LRT)

The use of LRT according to Ekasaputra, (2018), has several relative advantages such as: (1) Easy access, (2) free of barrier, (3) Short travel time, (4) Affordable tariff, (5) Scheduled, (6) Secure and comfortable, and (7) Environment friendly. The use of LRT passing through 17 stations, 1 Depo, three routes of LRT Jabodebek, namely: Cawang-Harjamukti, Cawang-Dukuh Atas, and Cawang-Jatimulya (Bekasi). LRT has five signaling systems (Figure 1) with headway of six minutes through 430 travels, with

the tariff of Rp 12,000 which people can afford it. Public sector wants to provide an LRT system which is cost efficient and responsive to the demand raised by climate change, so it is necessary to take consideration from the perspective of life cycle and fund raising from private sector swasta to ensure its continuity [30].

Integration of LRT as an urban transportation alternative, according to Ekasaputra, (2018) passes through three points in Jakarta namely; (1) Dukuh Atas passed by MRT, KCI, Airport train, Transjakarta, (2) Kampung Rambutan passed by Intercity bus and inner city public transportation, and (3) Cikoko, Pancoran, Kuningan, Rasuna Said, and Setiabudi passed by Transjakarta bus. For Example, that if handled well, it can predict the travel time to the area of Monumen Nasional Jakarta [6]. Now, in 2019, the density will lessen since many private car users shift to public transportation, whereas in 2024 the density will decrease because many private car users move to public transportation.

The main strategies in the Masterplan of Jakarta Transportation, based on Jakarta Governor's Decree in 2007 are; (1) the development of mass public transportation, including MRT, LRT, Bus Rapid Transit and Waterways, (2) traffic restriction by limiting the motor vehicle users, Road Pricing and Parking Control, and (3) the improvement of transportation facilities and infrastructures by developing Park and Ride, Road Network, Pedestrian and Area Traffic Control System (ATCS) [6]. Today, it is necessary to enhance people's activities by developing mass and modern transportation to result in fast, secure, efficient and big capacity transportation like MRT, LRT and BRT.

The development of mass public transportation with BRT according to [6]; is through the operation of 13 Corridors, Corridor 13 (Elevated), JR/Residence Connexion, JA/Airport Connexion and Hov/Bus Lane on Toll Road (BOS and contra flow) in addition to MRT/subway/commuter line with north-south corridor, east-west corridor, airport rail, high speed train, DDT (double-double track), and Jabodetabek commuter rail. In the meantime, the development of seven LRT lines is the priority of the development surrounding Jakarta. Based on the capacity and speed, urban train can be planned to be monorail or people movers, light rail, light metro and heavy metro.

Some considerations people take in selecting transportation mode are speed, punctuality, service, comfort, safety, interconnection of transportation mode, and tariff. The local government also plays roles in the railway development [6], for example in; (1) the development of railway infrastructures, (2) the status of infrastructure ownership, (3) licensing (business, development, operation), (4) the establishment of business entity, (5) integration with other modes, including Transjakarta bus, (6) preparing the budget, (7) IMO (Infrastructure Maintenance and Operation) and (8) PSO (Public Service Obligation). The PSO is intended to shift

passenger transportation from road to train. In terms of speed, travel time, and capacity of urban public transportation mode, the types of transportation that can be used are Bus, Tram, LRT, MRT/KRL and Double Decker. KRL traffic according to Sedayu, (2018) has been so crowded that disturbs the comfort of other motor vehicles at the crossing. The number of KRL passengers increases every year. Double decker KRL aims to increase the capacity to carry passengers in the same pattern of operation with the existing system.

E. Integration with Tram

The use of Tram, in the opinion of train researcher [7] is as the city Icon for Tourism, as traffic jam breaker and as an economic rise because it can enter a narrow area. Tram is intended to fill in the shortage of transportation in the areas where public transportation does not pass through, so that it can reduce the use of private motor vehicles. The development of tram uses the TOD concept so that the areas in which Tram passes through can become a new economic center. The concept of Tram development in Jakarta is proposed by [7] to take three places, namely; (1) From feeder to other public transportations, (2) Tourist areas (Gelora Bung Karno/GBK and Old City), and (3) Connection for poor areas to generate new economic centers. The areas potential for Tram development are Menteng, GBK (Senayan), Kota Tua, Kebayoran, Kemayoran, Grogol-Dermaga Ujung, Pluit Parang-Jembatan Pangkalan and Marunda-Tebet. Sedayu, (2018) adds that Tram runs using battery as its power supply, thus environmentally friendly and does not need line electrification. Tramset consists of three cars as long as 9 meter each, while the carbody low floor is designed for easy passenger access [7].

In France, according to another reseacher [31] Tram is not only a technical solution for traffic jam but also a symbol of cultural mutation in the urban development planning. Coupled with the encouragement of national politics for the cities which are more inclusive in social matters, Tram becomes the backbone of contemporary urban policy, or in French version TOD, especially for middle-size cities. Research on mass transportation in the form of Tram, as one of Surabaya Municipal Government programs in order to improve the traffic jam [32]. The rapid growth of mass transportation is also expected to be able to support the improvement of air quality in Surabaya due to the existence of CO (carbon monoxide) as a dangerous vehicle emission. Train technology is selected by comparing the use of three alternative vehicles, namely monorail with preferred index value 0.78, tramway with preferred index value 0.80, and LRT with preferred index value 0.84 [3].

A study on the use of Tram in Kemayoran area, according to [7], has a value of heritage which potentially increases the attractiveness of Tram. Tram can connect the tourist areas with their surrounding areas having potential to become tourist market area and museum. From analysis it is found that there are intervals among public transportation routes, so it needs new transportation lines

that can connect the existing lines and reduce traffic jam. Research on Tram in China done by [33] also evaluates the efficiency of modern Tram operation plan and the adjustment with the appropriate signal time of road traffic, and reflects the influence of interaction between tram signal and road traffic signal on the regional transportation network.

Tram development has been done in Spain and France with a good plan [34]. Users and residents see tram as a popular transportation mode [35]. Another study concerns the plan to use medium size electricity-powered buses which are able to pass through the routes where the rail-based transportation cannot do so [7].

F. Discussion

The trend of intermodal transport comprises eight factors, namely; (1) Marketing, indicating that the market in a regional and global area changes the supply chain pattern. Changes in supply chain will change the pattern of goods flow, (2) Expectation, with high services in the forms of speed, reach of service area, and goods security. Competition requires to reduce the operational cost as low as possible, (3) Competition, with inter-country even regional competition to be a center of industry. Inter-country competition is to provide logistic services, (4) Technology, with the most recent technology for the efficiency in transportation and pipeline visibility. Information and communication technology for the process efficiency requires investment in technology development, (5) Inter-mode, solution is needed to reach more areas. It requires adjustment of legal regulations for facilitation. It requires standardization, compatibility and multimodal terminal, (6) Energy, expensive energy gives suppress on the operational transaction. It is required to use cheap-energy and environment-friendly transportation as the response to global warming, (7) Security, the establishment of higher security procedure creates business barrier or high cost, and (8) Bottlenecks, the increase of infrastructure capacity and transportation devices is not as fast as the growth of cargo in the world.

To handle the integrated intermodal transport in the short term it needs; (1) Intermodal transport handling at port that changes the function of railway to be logistic manager, (2) rearrangement of airport train, (3) handling of single waybilling system, (4) rearrangement of national transportation system, and (5) logistic handling at dry port. In the long term it needs; (1) development of terminal and railway facilities and infrastructures to support intermodal transport with international standard, and (2) rearrangement of draft bill on intermodal transport.

The previous research, explains [36] that in Indonesia there has not been a metropolitan area which can create a sustainable transportation system. In its operation with several indicators, the metropolitan areas in Medan, Jakarta, Semarang, and Denpasar the system has run well. From the train development side, this research supports some previous researches such as the development of LRT Jabodebek (Cawang-Bekasi Timur) which is financially

and economically feasible so that it can be followed by alternative route planning [37]. Some researcher [38] give some proofs that railway transportation can provide feeder service for long distance flight service at airport hub, especially at those with train station. Railway integration in the inter-modal switching needs to be supported by minimizing the travel time to result in energy saving, optimum extra travel time as studied by [39] and [40].

Integration through Transit Oriented Development (TOD) according to [41] by utilizing land and transportation is the alternative solution to achieve the objectives of master plan and to solve urban problems such as traffic jam, to reduce travel time, and car dependency. In order to develop smart train in the railway integration it needs detail examination on various technologies and services which will revolutionize train industry and be able to face the current challenges [4].

A previous research in Britain [42] states that so far the integrated planning to operate train going to airport does not have a good coordination, so that the utilization of intermodal transport to airport is not so optimal. Concerning the use of Commuter Line in Bekasi, research by [43] indicates that the behavior in selecting a mode to and from station (Access Mode) and from station to destination (Egress Mode) is affected by the time value and transportation cost. With passengers' freedom to select the mode, transport service becomes faster but requires more cost. Future integration, according to [44] may offer positive alternative to the aircraft in some routes and lead to the travel by train to airport which is part of air transport service, and does not only provide access to airport.

Based on the explanation about the comparative study among train, LRT, MRT and Tram, this research supports some previous researches. Especially for the plan to use Tram, it still has to be studied in a further research, for example in Jakarta with the crowded traffic there are still level crossings between vehicles, Transjakarta buses.

IV. CONCLUSION

The result of this research needs railway transportation system as the integrator of intermodal transport in Jabodetabek area. To anticipate terrible traffic jam, it is necessary to develop an integrated mass transportation mode. In the long term, it needs to develop terminal facilities and infrastructures and railway organization to support intermodal transport with international standard and rearrangement of draft bill on intermodal transport. The integration of mass transportation mode in Jabodetabek is much needed with some routes of LRT, MRT, airport train, Commuter Line, KCIC, and BRT as well as integrated with the routes of Transjakarta.

An integrated development can be done through the development of railway infrastructures based on area development (TOD), developing the interconnection of mass transportation network in Jabodetabek, developing crowded urban areas around railway station using the

concept of TOD that can shorten the distance among office complex, plaza or mall, residential area as well as developing Park and Ride facilities at railway station. Transit Oriented Development has become the promising concept to integrate transportation.

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