Jakarta – Bandung high-speed rail project, facts and challenges

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Abstract. There are several factors that determine the success of high-speed operation. The first and most important is levels of ridership. The aims of this research is to examine whether level of ridership sufficient to cover its costs. Based on long experienced of Asia and Europe it is crucial to ensure level of ridership needed to justify the cost of high-speed systems similar to those in other countries range from eight million to ten million riders per line in the first year. However, given the current ridership level of existing conventional rail, on-going HSR project is unlikely to be able to achieve a level of ridership sufficient to cover its costs except a huge amount of highway travellers shift modes to high-speed to avoid driving in congestion and a significant percentage of induced traffic along the HSR line in a way that uses the high-speed services.

1 Introduction

Rail ridership in Indonesia has risen substantially in recent years, making decades of underinvestment and growing urban congestion important considerations for transport stakeholders as the central government through Ministry of Transport upgrade and construct new lines. Statistics Indonesia (BPS) reports that total rail passengers rose from 198.4 million in 2012 to 216.4 million in 2013, 271.9 million in 2014, 321.7 million in 2015 and 351.2 million in 2016. The amount of passenger-km in the same period are 14.4 million, 16.8 million, 14.4 million, 21.3 million and 20.7 million respectively, while the country's rail network remains limited to Java and Sumatera, with 5,368 km of total line operational in 2016 [1]. The Medium-Term Development Plan 2015-2019 includes an infrastructure development agenda that outlines projects such as having 3258 km of newly built or rehabilitated rail lines, made up of 2159 km of intercity railways and 1,099 km of urban railway, and boosting rail cargo volumes to 1.5 million twenty-foot equivalent units

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annually. Urban rail lines, including a planned light rail transit (LRT) system in Jakarta, are also expected to help reduce congestion and transport costs, which have become the highest in South-east Asia. One of the largest rail projects currently under development in Indonesia is a high-speed rail, 143-km line connecting Jakarta to Bandung, the capital of West Java Province. The train would reduce the travel time between the two cities to just 45 minutes. Intense competition between Japan and China to win the project tender ended with the September 2015 announcement that a US$5.9 billion contract had been awarded to Kereta Cepat Indonesia China (KCIC), a joint venture between China Railway International and four Indonesian state-owned enterprises. The Indonesian consortium comprises PT Wijaya Karya, a construction company, railway operator PT Kereta Api Indonesia, toll-road builder PT Jasa Marga, and PT Perkebunan Nusantara VIII, a plantation company. It was said that the China's offer for not requiring an official loan guarantee nor funding from Indonesia was the primary factor affected the government's decision.

There are several factors that determine the success of high-speed operation. The first and most important is levels of ridership. Daily passenger flow on the rail link is expected to be 29,000 on average, with this number increasing in later years [2]. The aim of this research is, therefore, to explore whether the Jakarta-Bandung high-speed rail may produce sufficient ridership for cost-effective operation based on current experiences of selected Asian and Europe countries. This research addresses the following parts: definition of high speed rail, methodology, evaluation of the HSR project, discussion and conclusion.

2 Definition of high-speed rail

High-speed rail (HSR) has different definitions in different countries. According to the International Union of Railways (UIC), the European Union defines high-speed rail as lines specially built for speeds greater than or equal to 250 km/hour, or lines that are specially upgraded with speeds greater than 200 km/hour [3]. According to the Indonesian Rail Law No 23/2007 (Undang-Undang Perkeretaapian), high-speed rail defined simply as lines for speeds greater than 200 km/hour [4]. Based on UIC definition there are four major types of high-speed rail operation:

2.1 Dedicated

Japan's Shinkansen is an example of dedicated service with separate high-speed tracks that exclusively serve high-speed trains. The system was developed because the existing rail network was heavily congested with conventional passenger and freight trains and the track gauge did not support the new high-speed trains [5].

2.2 Mixed high-speed

Exemplified by France's TGV (Train à Grande Vitesse), this model includes both dedicated, high-speed tracks that serve only high-speed trains and upgraded, conventional tracks that serve both high-speed and conventional trains.

2.3 Mixed conventional

Spain's AVE (Alta Velocidad Española) has dedicated, high-speed, standard-gauge tracks that serve both high-speed and conventional trains equipped with a gauge-changing system, and conventional, nonstandard gauge tracks that serve only conventional trains.

2.4 Fully mixed

In this model, exemplified by Germany's ICE (Inter-City Express), most of the tracks are compatible with all high-speed, conventional passenger and freight trains.

According to those types of HSR operation and proposed route by KCIC as passenger dedicated line, the Jakarta-Bandung HSR, therefore categorized fully dedicated type without chance to share the track for freight. While the conventional line, the Parahyangan, was built with and is still using narrow-gauge and its track gauge did not support the proposed Jakarta-Bandung HSR.

3 Methodology: case comparisons

We compare the proposed Jakarta-Bandung HSR corridor with the some of HSR corridors in Asia and Europe regions to assess relative accessibility of potential demand as determined by urban structural factors. International comparison is especially important in HSR because the research shows important differences across countries due to topography, demographics, nature of transit demand and government investment schemes [5, 11]. Probably Jakarta – Bandung high-speed rail is almost similar with HSR in China that has started from a single 113 kilometres demonstrated line built specially for the 2008 Beijing Olympics. That first Beijing – Tianjin line took three years to build and China rail passenger numbers are growing 10% annual growth.

4 Evaluation of Jakarta to Bandung HSR

4.1 Project description

Plans and studies have been in the works for HSR in Indonesia since before 2010, yet a revised plan to build a high-speed rail in Indonesia was announced by Indonesian Government in July 2015. The Indonesia's first high-speed rail project is proposed to connect the national capital Jakarta with Bandung city in neighbouring West Java province, covering the distance of 143 kilometres as shown Figure 1.

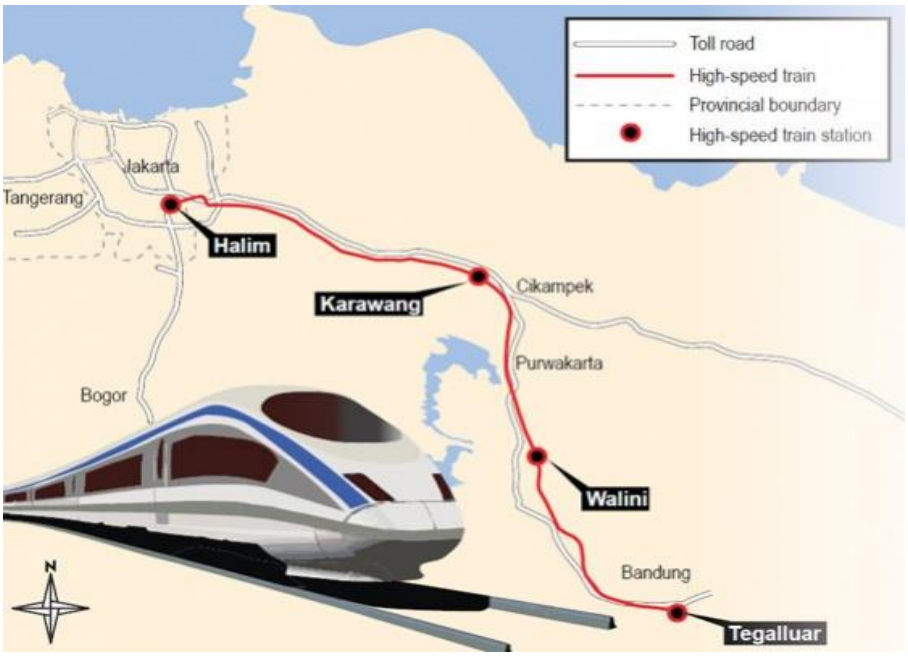

Fig. 1. Route of Jakarta to Bandung high-speed rail

The project is financed through a Chinese loan provided by China Development Bank which provides around 75 percent of the funding with the rest arranged by the joint venture partners. Daily passenger flow on the 143-kilometer link is expected to be 29,000 on average in the first year of operation with this number increasing in later years. The project will be carried out on a business-to-business basis, with Indonesia having 60% interest in the joint venture, while China has 40%. Table 1 displays brief data of HSR line.

Stations and their surrounding areas will experience an increase in activity and development, which will result in new opportunities for the real estate sector through transit oriented developments (TOD) approach. The construction process is expected to be completed at the end of 2019. The certification trial is scheduled to be held in the first quarter of 2020. All of the technology, standards and equipment would be from China include technical standards, survey and design, engineering construction, equipment manufacturing, material supply, operation management to human resource training. As a double-track railway, the route will serve four stations in its first phase as described in Figure 1. Concession period is 50 years from May 31, 2019 and cannot be prolonged, except in force majeure situation [6]. President Joko Widodo ground breaking the project on January 21, 2016.

Table 1. Brief data of HSR line [7]

Element	Data
Termini	Halim (Jakarta) ~ Tegalluar (Bandung)
Intermediate station	Karawang and Walini (West Java)
Route length	Approximately 143 km
Schedule train frequency	Every 35 min (first year operation)
Job opportunity	39,000 jobs-HSR construction
	20,000 jobs-TOD construction
	28,000-HSR and TOD operation
Payback period of investment	40.2 years-without TOD
	23.74 years-with TOD
Ticket price	IDR 225,000 (US$16)
Speed	Maximum operating speed 350 km/h
Estimated journey time	Between Halim and Tegalluar:45 min
Revenue from ticket sales	US$ 168 million (2020)
Commencement date	2020
Estimated completion date	2020
Passenger flow volume (2020)	About 29,000 passengers per day
Project costs	US$ 5.135 billion-without TOD
	US$ 5.294 billion-with TOD
Terms of loan (40 years loans period)	60% in US$ with interest 2%/year
	40% in RMB with interest 3.46%/year
Concession period	50 years (31 Mei 2019 ~ 31 Mei 2069)

4.2 Forecasting ridership

While the level of understanding and the amount of data regarding travel behaviour has never been better, significant uncertainty remains. High risk of HSR investments due to capital investments is both long-term and high cost and limited flexibility where rails and stations cannot be moved to stronger market [8]. While new transport demands are emerging and existing transport needs are growing, the China Railways Corporation (CRC) network is already one of the most densely used in the world, with robust growth between 2009 and 2013. Overall passenger traffic grew by 5.5% per year during this period reaching 2.1 billion passengers or 1060 billion passenger-km in 2013. Rail freight grew by 6% per year to 3.6 billion tonnes, or 2,633 billion tonne-km in 2013. These are large volumes

compared with the size of the network (103,100 km in 2013). The two busiest lines are Beijing - Shanghai and Beijing - Guangzhou, each estimated to carry more than 100 million passengers in 2014. Few of these passengers travelled end-to-end and the average trip length on both corridors is about 500 km. The first long-distance line, the 969 km Wuhan - Guangzhou line carried around 50 million passengers in 2013, about 14 million of whom came from interline traffic, illustrating network effects. Around half of the ridership on this route came from conventional services with the remaining traffic being new-to-rail. According to a report in the People's Railway Post in January 2014, the average seat occupancy on China Rail High Speed (CRH) services was 70% in 2013 [9].

According to estimates calculated by [10], investment in HSR is difficult to justify when the expected first-year demand is below 8–10 million passengers for a line of 500 km, a distance at which HSR's competitive advantage over road and air transport is clear. The economic rationale for new HSR infrastructure depends heavily then on the expected volume of demand. Thus, building an HSR line should only be considered in the case of links with high demand expectations for rail travel, i.e., routes connecting densely populated metropolitan areas, with severe problems of road congestion, and a deficient air connection as mentioned by [11].

Based on this figure it is crucial to ensure level of ridership needed to justify the cost of high-speed systems similar to those in other countries range from eight million to ten million riders per line in the first year. While this amount may be realistic in China, Japan and Europe it would be challenging to reach such number in Jakarta-Bandung HSR line. By comparison, Parahyangan conventional line, which began operating in 1971 and serve city pairs along the most densely populated corridor, only carries a total of 560,320 passengers in 2016 [12]. Overall, however, diverted Parahyangan rail passengers have not been a major source of high speed rail ridership. Therefore, HSR trips compromised the majority from car, induced traffic and less both from air and diverted conventional passenger rail along the line.

Based on KCIC as described in Table 1, it was forecast that the new HSR line would attract around 10 million passengers per year in first year of operation, although a few of these would only use part of the route. This high figure reflects the high population density of Jakarta, and the large number of origin destination pairs that the line would serve. In terms of expected annual demand growth for new HSR lines, aggregated traffic in Asia and Europe during the 1994 – 2004 period provides demand trends as shown in Figure 2.

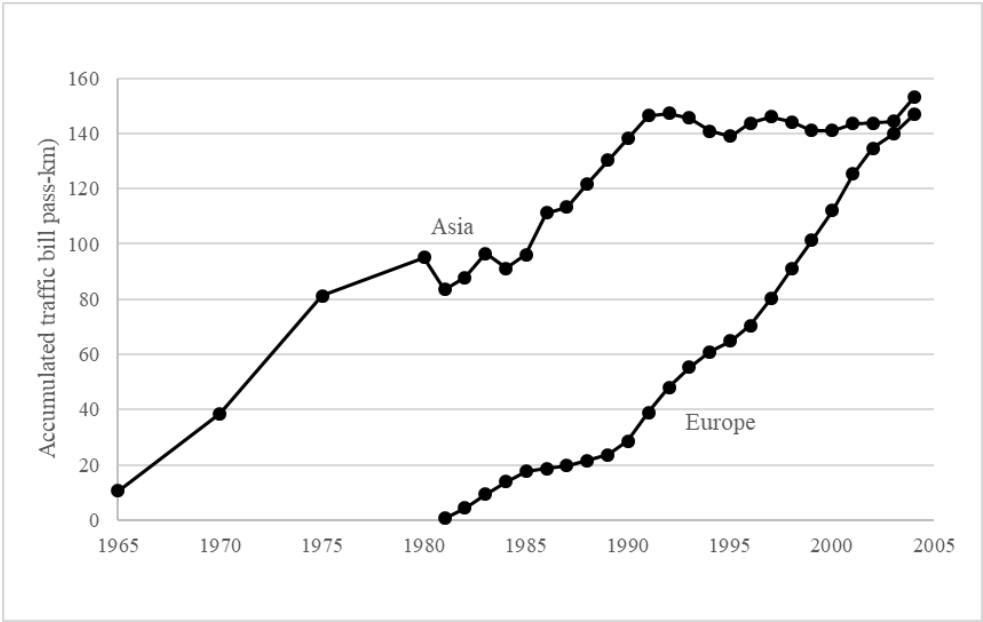

Fig. 2. Accumulated HSR traffic [13]

Shinkansen services in Japan enjoyed a sustained traffic growth for the following 20-years, where during this period it gained around 100 billion passenger-km. However, in the next 20-years interval (from 1994 to 2004), accumulated demand growth halved, and only 50 billion additional passenger-km used HSR. By comparison, most European HSR projects are still in their first 20-year period, and therefore it is natural to expect high growth rates as expressed by Figure 3) at least until the HSR markets start to mature as in Japan. Graph 2 shows accumulated traffic used the HSR services in Asia and Europe based on traffic data from each operator during the 2010 to 2016 period. As confirmed by Figure 4 the only China is still in it incredible constant growth and gained a huge accumulated traffic around 850 billion passenger-km. Two other Asian countries i.e. South Korea and Taiwan started HSR services in first decade of 21 centuries only gained accumulated traffic of 31.4 and 20.2 billion passenger-km respectively during the same period. Based on long experienced of HSR services in Japan and Europe countries it is easy to predict that most China HSR projects still enjoyed a constant traffic growth for the next two decades most triggering by combined building new dedicated electrified lines and upgrading existing lines. Both South Korea and Taiwan HSR service expressed constant demand growth for the following first decade even the Korea Train Express (KTX) has transported approximately 150 million passengers since the four years after its opening. Taiwan HSR itself has carried about 100,000 passengers per day for fifty first months of commercial service. However, Shinkansen services is still in its positive growth and gained accumulated traffic of 196 billion passenger-km from 2010 to 2016, two times higher than France figures of 99.1 billion passenger-km during the same period. It is important to note that France HSR experienced a stagnant traffic growth from 2010 to 2016; in 2016 as an example, SNCF collected accumulated traffic of 49.1 billion passenger-km, otherwise in 2010 it figure still stand on 51.9 billion passenger-km. Other Europe HSR operators include Dutch, England, and Sweden indicated sustained traffic growth and collected accumulated traffic around 42 billion passenger-km until the end of 2016 as presents in Figure 3.

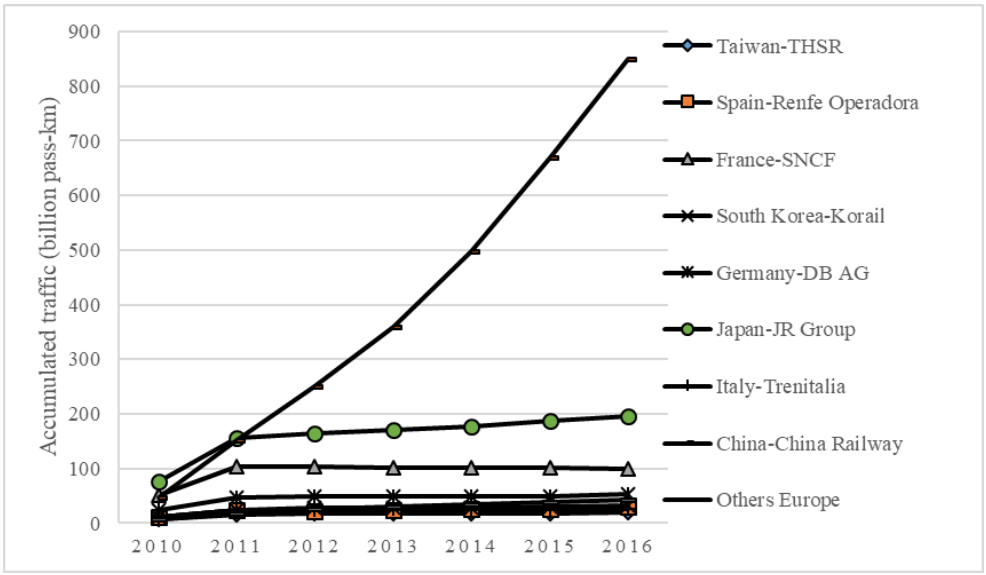

Fig. 3. Accumulated HSR traffic from 2010 to 2016 [14]

According to passenger traffic data from Europe and Asia, the first HSR line in Indonesia is expected to gain substantial amounts of demand. However, it is important to note that most Europe and Asian countries built HSR lines because their conventional lines were so successful that they needed to add a new capacity to increase rail service. Many of these lines already had double or triple tracking. Hence, the high demand for conventional rail created a market for HSR. It is inevitable to mention that Indonesia include Jakarta and Bandung with the highest population density are still lacking in this factor that triggered HSR services successful in Europe and Asian countries [15].

5 Discussion

The railway system in Indonesia was established in the second half of the 19th century under the Dutch colonial administration. Rail was a very important mode of cargo and passenger's transportation, and when at its peak in 1939, the total railway length was 6,324 km on Java and 1,833 km on Sumatera. However, 70 years later the figures had fallen substantially to 3,464 km on Java and 1,350 km on Sumatera Island [16]. Competition with road transport was the primary reason for this decline. Nevertheless, rail is still considered more superior than other modes of transport for a number of reasons: loading capacity, energy and space efficiency, safety, and less pollution and carbon emission. For those reasons, Law No. 23/2007 on railways was enacted to make rail an important mode of transport again. However, building high-speed rail is expensive; it involves a significant amount of investment costs and may substantially compromise both the transport policy of a country and the development of its transport sector for decades. Based on these reasons, it deserves a closer look, well beyond the technological hype and the demand figures. Since China's offer to build the Jakarta–Bandung line without requiring an official loan guarantee nor funding from Indonesia, ridership is the critical element in determining the viability of a large capital considering the current ridership levels on existing Jakarta-Bandung intercity rail (Parahyangan).

Otherwise, in capital Jakarta and Bandung alone where the population is almost 13 million, the transportation infrastructure has not been developed sufficiently to cope with

such a large scale of population. The railway service, in particular, is less competitive in terms of the required time than passenger cars, so that more than 80% of passengers rely on the passenger cars as transportation means. Therefore, since the traffic congestion has been serious due to the increasing number of cars mainly in the urban areas, the necessity of inter-city connection by railway has been identified. Hence, the high-speed rail between Jakarta and Bandung has been nominated as Priority Project in Master Plan for JABODETABEK Metropolitan Priority Area (MPA).

6 Conclusion

Research has shown that high-speed rail promotes urban investment and concentrates economic activity in and around stations. This might help high-speed rail stations become nodes of denser urban development in the future and could, if linked to the metro transit system, encourage transit oriented development along Jakarta and Bandung regions. Otherwise, the Parahyangan conventional line, which began operating in 1971 in the corridor only carries a total of 560,320 passengers in 2016. However, given the current ridership level of existing conventional rail, even with 10% annual growth as expressed by China, on-going HSR project is unlikely to be able to achieve a level of ridership sufficient to cover its costs as currently planned except a huge amount of highway travellers shift modes to high-speed to avoid driving in congestion and a significant percentage of induced traffic along the HSR corridor in a way that uses the high-speed services. In the mid and long terms, the central and local governments could consider the implementation of the more effective way to shape regional growth, prevent sprawl and grow smart through a series of transit oriented development along Jakarta – Bandung high-speed rail system and grow this into an extensive network. When combined with regional rail and metro system along high-speed rail corridor, a complete and integrated rail network is achieved enabling easy, fast mobility and increase ridership.

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