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# Jakarta-Bandung High-Speed rail transportation 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

The Constitution of the Republic of Indonesia Year 1945 states that the national goal is to protect the people and the country of Indonesia and to promote the general welfare for, including the convenient transportation such as Railway transportation [1]. 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 [2].

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 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 KeretaCepat Indonesia China (KCIC), a joint venture between China Railway International and four Indonesian state-owned enterprises. The Indonesian consortium comprises PT WijayaKarya, a construction company, railway operator PT. KeretaApi Indonesia, toll-road builder PT. JasaMarga, 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.

Several factors 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 [3]. 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. According to the researchers searches there are not net any researches which discuss about this in Indonesia due to the Project of HSR is the first time do in Indonesia. This research addresses the following parts: definition of high speed rail, methodology, evaluation of the HSR project, discussion and conclusion with Indonesia Evidence.

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## **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 [4]. According to the Indonesian Rail Law No 23/2007 (Undang-

UndangPerkeretaapian), high-speed rail defined simply as lines for speeds greater than 200 km/hour [5]. Based on UIC definition there are four major types of high-speed rail operation:

#### *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 [6].

#### *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.

#### *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.

#### *Fully mixed*

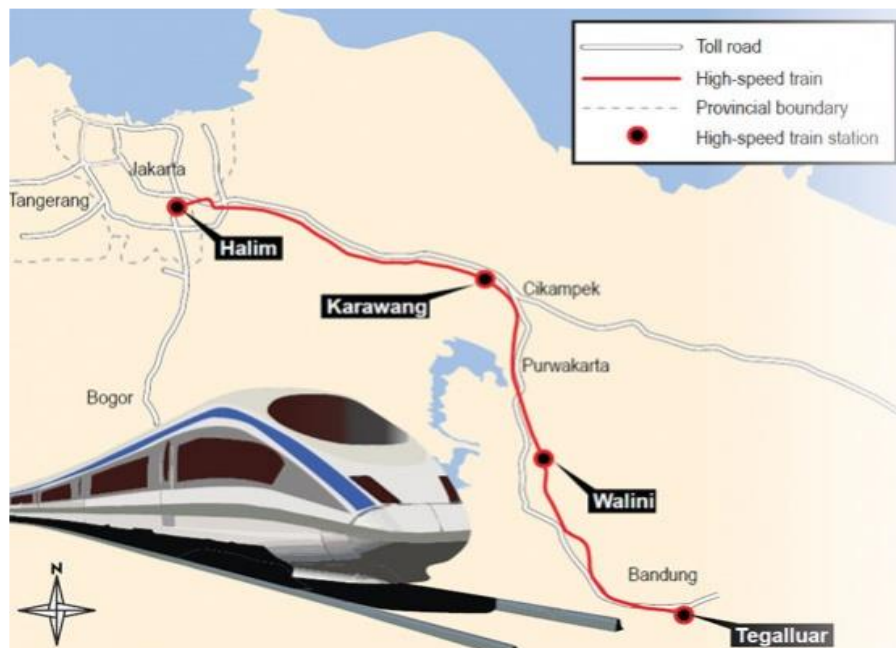
In this model, exemplified by Germany's ICE (Inter-City Express), most of the tracks are compatible with all high-speed, conventional passenger and freight trains.

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. Evaluation of Jakarta to Bandung HSR

#### *Space considerations*

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 in Figure 1.



**Figure 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 [7]. 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 May 2019 ~ 31 May 2069)

### *Forecasting ridership*

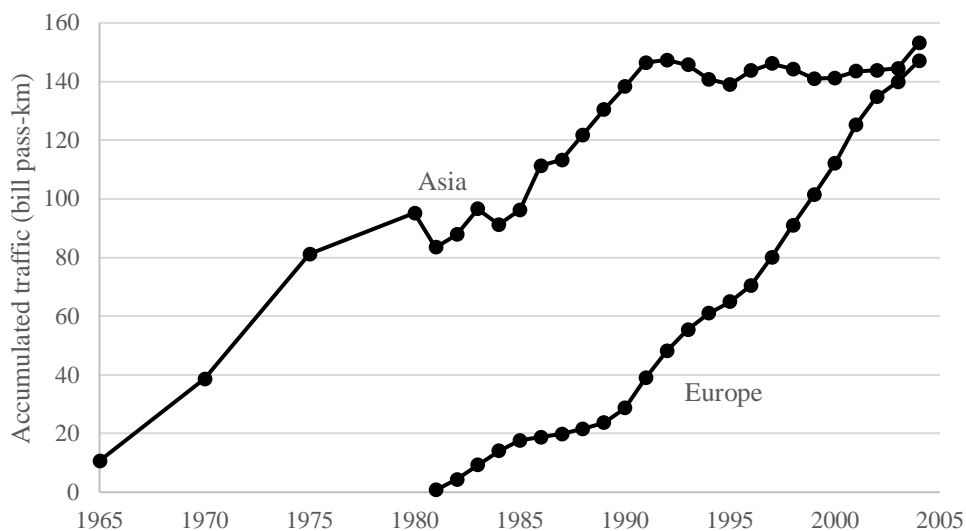
While the level of understanding and the amount of data regarding travel behaviour has never been better, significant uncertainty remains. High risk of HSR investments due to capital investments is both long-term and high cost and limited flexibility where rails and stations cannot be relocated to stronger market [9]. 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 who 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 [10].

According to estimates calculated by [11], 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 [12].

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 [13]. 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.

As per the information data from KCIC as explained in Table 1, it is estimated that the new HSR line will attract around 10 million passengers per year in the first year of operation, although some of these will only use a portion of the route. This high number reflects Jakarta's high population density, and the large number of original destination pairs served by the line. In terms of expected annual demand growth for new HSR lines, aggregate traffic in Asia and Europe during the 1994-2004 periods provided a demand trend as shown in Figure 2.



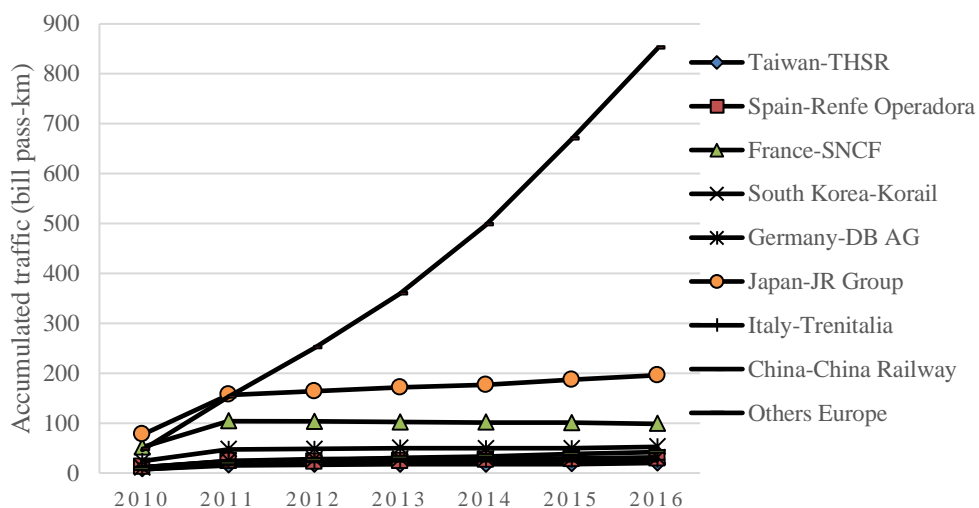
**Figure 2.** Accumulated HSR traffic [14]

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 Fig. 2) at least until the HSR markets start to mature as in Japan. Fig. 3 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 Fig. 3 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. 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.

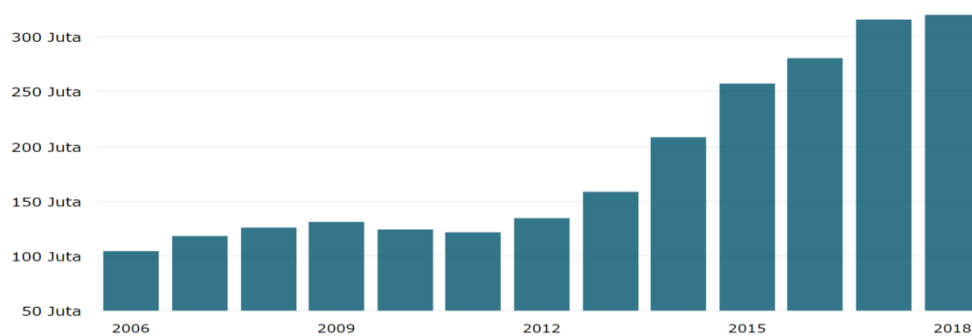


**Figure 3.**Accumulated HSR traffic from 2010 to 2016 [15]

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 [16].

#### 4. Facts and Challenges

As well known that railway is the massive public transport systems and become the natural part of the development of urban infrastructure in developed and developing countries' cities. However, urban cities in developing countries still struggled in this respect due to financial and institutional limitations [17]. The renewal process of the electronic commuter line (ECL) so the electric train ticket system which experienced delays has caused a long queue of passengers at several stations at the beginning of last week. Based on data from PT Kereta Commuter Indonesia (KCI) the number of ECL passenger throughout the year of 2017 reached from 315.8 million passengers, up to 12.55% from the previous one. This amount is around 868 thousand / day, so you can imagine if there is a problem with the public transportation mode. For this year, KCI targets the number of KRL passengers to increase to 320 million people or an average of 879 thousand / day [18].



**Figure 4.** Total Commuter Line passenger Jabodetabek (2006-2018E) 2018.

Source: Databoks, Indonesia.

As displayed in the figure 4 above it is proving that the demand of the commuter line in the Jakarta, Bogor, Depok, Tangerang and Bekasi are going increasing from year 2016 till 2018 (year 2018 is predicted). This is the fact of the urgently needs on preparing the transportation not only Jabodetabek but also Jakarta – Bandung as well as the countrywide.

The other facts as displayed figure 5 and 6, the overcrowded of the railway passengers due the demand especially in morning and evening time because they should arrive in their work on time. It is very dangerous deed but they are willing to do that due to the life struggle.

According to Joni Martinus the information manager of PT KAI Daop II Bandung West Java informed that Bandung-Jakarta wants more sales growth. He added, one of the transportation problems in Indonesia is the length of time due to traffic jams. With the availability of jam-free mass transportation, it is expected to boost tourism in an area. [19].

**The Challenges:** This empirical evidence of the ridership growth trends and conditions as well as high demand from the society with respect to the role of central government republic Indonesia in provide the high-capacity public transport systems. This growth is triggered by the increasing number of available seat capacity due to the emergence in Indonesia which accelerates the growth of passenger of the Railway transportation sector from year to year [20, 21]. Availability HSR; such high-capacity public transport systems are primarily appropriate for large and dense for serving the urban agglomerations. Then it will be play the important parts for integrating the massive public transportation systems for this country.

**Innovation Service Delivery Urgently Required:** The HSR public transportation systems play very important social, economic and environmental roles in terms of facilitating more efficient urban mobility systems and will give the sustainable service towards the urban development patterns. From the initial, construction, testing and handing over this project will face a number of obstacles which needed innovations to overcome them [22, 23]. The usage of ICT in giving fast and quality service delivery is requiredly needed in every activity for this such transportation in Indonesia [24].



Integration is important for public transport systems to be efficient and sustainable. The most efficient systems are those that have achieved route integration; integration with other public transport systems by implementing ICT application service delivery in order to integrate services of ticketing, accommodation, local inland transportation and etc. By providing good systems and facilities such as HSR provide, will be expected ridership satisfaction and be able to increase customer loyalty to use this service [25]. In addition, service quality is expected to be able to attract passengers. While the number of innovative high-tech products and services is increasing as we speak, consumers' experiences with these products and services are becoming a focal point for organization or companies striving to grow and sustainability [26].

## 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 [27]. 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 [28]. 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 [29]. 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.

## 7. References

- [1] Purba J, Rajagukguk W 2016 Strategic Planning and Foresight on National Development Through Education: Nusantara Nationwide Evidence. IcoNS Universitas Indonesia, 24-25 November
- [2] Transportation Statistics 2016 (Ministry of Transportation, Jakarta)
- [3] High Speed Railway (HSR) Jakarta - Bandung, the Acceleration of Infrastructure in West Java 2016 (Ministry of Transportation, Jakarta)
- [4] International Union of Railways, General Definitions of Highspeed 2012 : <http://www.uic.org/spip.php?article971>
- [5] Indonesian Rail Law No 23/2007
- [6] Campos J, de Rus G 2009 *J. Transport Policy* **16**, 1 pp 19-28
- [7] Chaiboonsri C, Chaitip P 2017 *The EUrASEANs: Journal on Global Socio-Economic Dynamics* **3(4)** pp 26-38.
- [8] High Speed Railway (HSR) Jakarta - Bandung, the Acceleration of Infrastructure in West Java 2016 (Ministry of Transportation, Jakarta)
- [9] Polzin S E et al. 2014 *Fifth Annual William O. Lipinski Symposium on Transportation*
- [10] Ollivier G Et al. 2015 *J. International Railway* **19**
- [11] de Rus G, Nombela G 2007 *J. of Transport Economics and Policy (JTEP)*, **41**, **1** pp 3-23
- [12] Albalade D, Bel G 2010 High-Speed Rail: Lessons for Policy Makers from Experiences Abroad (Research Institute of Applied Economics, University de Barcelona)
- [13] Vinichenko M V et al. 2019 *Espacios* **40 (19)**
- [14] International Union of Railways (UIC) 2005 Estimation des ressources et des activités économiques liées a la grande vitesse. Prepared by CENIT (Center for Innovation in Transport, Universitat Politecnica de Catalunya)
- [15] Railway Statistics 2015 (International Union of Railways)
- [16] Purba A *High-Speed Rail : Lesson Learned from Developing Countries* (to be published)
- [17] Purba A 2018 *Planning and Design for Sustainable Urban Mobility* : [https:// unhabitat.org/wp-content/uploads/2013/06/GRHS.2013.03.pdf](https://unhabitat.org/wp-content/uploads/2013/06/GRHS.2013.03.pdf)
- [18] [https:// databoks.katadata.co.id/datapublish/2018/07/24/berapa-penumpang-krl-jabodetabek](https://databoks.katadata.co.id/datapublish/2018/07/24/berapa-penumpang-krl-jabodetabek).
- [19] Martinus J 2017: <https://www.republika.co.id/berita/ekonomi/korporasi/17/09/14/ow9i4g335-penumpang-ka-bandungjakarta-meningkat-20-persen>
- [20] Banuara S, Purba J 2017 *J. Manajemen dan Pemasaran Jasa* : <https://www.trijurnal.lemlit.trisakti.ac.id/index.php/jasa/article/view/2164pj.v9i2.2057>
- [21] Hata T 2003 *Japan Railway & Transport Review* **35** pp 36–44)
- [22] Purba J, Panday R 2018 *Innovation Strategy Services Delivery: An Empirical Case Study of Academic Information Systems in Higher Education Institution* (Springer)
- [23] Panday R, Purba J 2014 *Proceeding. ICOI International Conference of Organizational Innovation* (DLSU Manila)
- [24] Purba J 2014 *Proceeding. 12<sup>th</sup> International Annual Symposium on Management*. 12
- [25] Panday R, Purba J 2014 *Proceeding. ICOI International Conference of Organizational Innovation* (DLSU Manila)
- [26] Purba J, Kamaludin 2016 *Proceeding. The Fifth International Conference on Entrepreneurship and Business* (Tainan, Taiwan)
- [27] Master Plan of National Railway 2011 (Directorate General of Railway, Ministry of Transportation, Indonesia)
- [28] Ushakov D, Vinichenko M, Frolova E. 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **272** 032111
- [29] Ushakov D 2016 *Actual Problem of Economy* **1(175)** pp 94-104