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SUCCESS FACTORS OF THE ASIA AND EUROPE HIGH SPEED RAIL: LESSON LEARNED FOR INDONESIA AS THE MASSIVE STRATEGY SERVICES

Aleksander Purba
Civil Engineering Department, Faculty of Engineering, Universitas Lampung, Bandar Lampung 35145, Indonesia

Fumihiko Nakamura
Graduate School of Urban Innovation, Yokohama National University, Yokohama 240-8501, Japan

John Tampil Purba
Management Department, Faculty of Economics, Universitas Pelita Harapan, Karawaci, Banten 15811, Indonesia

Chatarina Niken DWSBU, Dwi Herianto and Muhammad Jafri
Civil Engineering Department, Faculty of Engineering, Universitas Lampung, Bandar Lampung 35145, Indonesia

ABSTRACT

Southeast Asia might have its first high-speed rail (HSR) project in the next few years. Located in Indonesia, this project is expected to connect Indonesia's capital Jakarta with the neighboring city Bandung in around 150 kilometers of distance. Proponents and critics have been addressed to this plan but only small amount of research has been conducted to examine HSR's operating system in Asia and Europe and the rate of success of HSR implementation in Indonesia. The objective of this paper is to provide an estimate of the total cost of building, operating and maintaining a HSR with technical characteristics and the supply and demand conditions based on Asia and Europe experiences. Although the calculation formula provides a lower bound to the actual cost, this expression summarizes the critical factors that must be taken into account when analyzing the costs of HSR lines. These include the line length, the number of trains needed to respond to the demand, train capacity, average distance and the corresponding unit costs. This understanding is very important and meaningful for Indonesia's future projects as it will lead to a better analysis of the expected construction and operating costs. Moreover, the number of passengers to be *transported that are differentiated by economic and geographic conditions, and becomes the urgently service delivery to the nation people. This paper also provides suggestions and recommendations toward the government in considering the total service community.*

Keywords: Asia and Europe, critical factor, high-speed rail, Indonesia, total costs

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1. INTRODUCTION

Indonesia development in number aspects will be affected even directly or indirectly with enforced by ASEAN Free Trade Area (AFTA) that gradually in the scope of the ASEAN countries since 2003. From the end of 2015 the ASEAN Economic Community (AEC) the free trade already implemented throughout the Asia Pacific region. Then, the transportation infrastructure shall be provided [1]. Development of a transport infrastructure relates to the need of creating connectivity between cities within a specific allocated travel time. Jakarta and Surabaya, as two major economic powerhouses in Indonesia, still need improvement in term of connectivity [2]. Plans and studies for HSR in Indonesia are not recent as they have been conducted since before 2010. However, a new plan to build HSR was just recently announced in 2015. The new HSR is expected to connect Indonesia's capital city Jakarta and the neighboring city Bandung in West Java. It will cover approximately 150 kilometers of distance. Future plan of the HSR was also mentioned as it has been planned to be extended to Indonesia's second largest city Surabaya in East Java. Japan and China are two countries who indicated high interest in this project. Both countries carried out comprehensive studies for Jakarta-Bandung section (150 km). However, only Japan International Corporation Agency (JICA) who had issued a study for extension project (730 km).

The rivalry ended once the Indonesian Government awarded the HSR project to China in September 2015. 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. After that, route permit for Jakarta-Bandung HSR project (142.3 km) was officially released by the Minister of Transportation in January 2016 with stations located at Halim (Jakarta end), Karawang, Walini, and Tegalluar (Bandung end). As for Tegalluar, it will not only have a station but also depo. It was first considered to have a departure point at the Jakarta end, which is the inner city railway station of Gambir. However, it was declined due to the consideration that the construction of Gambir-Halim leg would add complications. Therefore, the link would only be from Halim (Jakarta) to Tegalluar (Bandung) with a cost of US$5.135 billion. As for concession period, it was determined to be 50 years from May 31, 2019 and cannot be prolonged unless a force-majeure situation occurs. Groundbreaking has been done on January 21, 2016. The composition of the HSR project is 60 percent of Indonesian consortium and 40 percent of China Railway International. The Jakarta-Bandung high-speed rail is expected to operate in 2019. The Japanese proposal can start operation only by 2023. As for Bandung-Surabaya section, though a priority section due to heavy congestion, has been officially shelved for budget reason since early 2015 [3], as seen in Figure 1.

Figure. 1 Proposed Java high speed rail.

Proponents and critics have been addressed to this plan but only small amount of research has been conducted to examine HSR's operating system in Asia and Europe and the rate of success of HSR implementation in those countries. There are a number of researches about HSR in this world however in this paper will contribute the appropriate choices for the government of Indonesia by doing the examinations of prospects according to Indonesian perspectives approach which different to the previous researches. This research will examine the prospects of HSR in Indonesia and the results of this study are different from Japan, China, and Europe in terms of travel patterns, spatial structure, car ownership and etc. It uses these results to determine whether HSR is a realistic prospect for Indonesia country accordingly. This study addresses the following parts: a brief history and definition of high speed rail, methods, the factors determining the success of the HSR, and conclusion.

2. BRIEF HISTORY AND DEFINITION OF HSR

In many parts of the world, high speed rail can be defined differently. Arguably, there is no absolute definition of high-speed Rail. In the US, high speed rail can be defined into three categories such as follows: emerging rail with the speed of 90 to 110 mph; regional rail with the speed of 110 to 150 mph; and express rail with the minimum speed of 150 mph [4]. While in the European Union, as it is defined by the International Union of Railways [5], High Speed Rail can be defined as special-built lines with speeds greater than or equal to 250 km/h or specially upgraded lines with the minimum speed of 200 km/h. Due to its broad definition, High Speed Rail is now classified into four major types [6]:

2.1. Fully Dedicated

It can be defined as a dedicated service for high speed trains with separated tracks. One example for this fully dedicated system is Japan's Shinkansen. Shinkansen's rail network is developed separately because of the highly-congested existing rail network with passenger and freight trains. Moreover, the existing track gauge does not meet the demand to support the high speed trains.

2.2. Mixed High Speed

One example for this system is France's TGV which uses both dedicated and conventional tracks. The high speed tracks can serve only high speed trains and upgraded, while the conventional tracks can serve both high speed and conventional trains.

2.3. Mixed Conventional

Spain's AVE is a good example for the mixed conventional type. It uses standard gauge tracks which serve both high speed and conventional trains equipped with the gauge-changing system. Conventional and non-standard gauge tracks exist to serve only conventional trains.

2.4. Fully Mixed

It can be defined as lines or tracks built to meet the demand of all high speed and other types of trains. In this case, Germany's ICE (Inter-City Express) is a good example as most of the tracks are compatible with all high speed, conventional passenger, and freight trains.

Six of the most extensive high speed rail system in the world is currently owned by China, France, Germany, Italy, Japan and Spain, in which, the world first was built and developed in Japan (Table 1). It was built in 1964 known as the Tokaido Shinkansen. The line connects Tokyo and Shin-Osaka and was built to expand the capacity of an overcrowded route. The line was constructed using loans from the World Bank and the Japanese Government in which the railway company repaid in seven years. After that, operating profits were diverted to cross subsidize local trains. This has successfully encouraged the Japanese government to expand high speed lines throughout the country.

Table 1 HSR-Km by Country in Operation and Under Construction

Country	HSR-km	Country	HSR-km
Austria	502	Poland	407
Belgium	209	Russia	1,496
China	37,155	South Korea	1,404
Denmark	65	Spain	4,900
France	2,793	Switzerland	137
Germany	1,762	Taiwan	348
Indonesia	143	Turkey	2,926
Italy	1,084	United Kingdom	1,377
Japan	3,446	U.S.	845
Netherland	120	Uzbekistan	344
Norway	18		

The second line, known as the Sanyo Shinkansen, came close to breaking even. Unfortunately, none of the other lines were able to generate enough passengers to cover their operating costs, not even their capital costs. Some of Japan's High Speed Rail networks were even built due to political pressure. As a result, they were not economically efficient. Partly as a result of large operating losses, Japan National Railways was privatized in 1987. Since then, the extension of HSR has continued, and it was supported by the idea that infrastructure spending can stimulate economic growth [7]. Japan currently has 2,700 km tracks and operate with 240-295 km/h of top speed and more lines under construction.

Italy became the second country to open the world's second HSR line in 1977. The line connects Rome and Florence. Italy currently owns two lines which connect Turin and Venice; Milan and Salermo. Parts of Milan-Salermo remain under construction. Italy has put efforts to slowly expand its track to connect major cities by HSR. However, the expansion progress has declined over the past two decades. The world's third HSR system was built in France referred as TGV which the first line was opened in 1981 between Paris and Lyon. As of 2014, France had approximately 1,895 km of HSR lines. Unlike Japanese system, where some lines do not connect with Tokyo, Paris becomes the hub where its spokes radiating outward. France's system has been expanded to Belgium, Germany, Italy, and Switzerland and is currently the longest in Europe which can operate up to 322 km/h of top speed.

Germany was encouraged by Italy and France, thus its leaders made HSR a national priority. As a result, Article 87 of German Constitution makes rail transport a government responsibility. The construction began two years after France's construction. However, lawsuits slowed the construction down and the first line, which connects Hamburg and Munich, did not open until 1991. As of 2014, Germany had a total of eight lines with more than 1,620 km in length.

In 1992, Spain opened its first HSR line and now has four separate networks. As of 2014, Spain had HSR system with 1,768 km in length. Practically, making it the second longest HSR system in Europe. Spain is known as a country which has been spending more money on rail than roads ever since 2003. However, the recent election of the conservative government, coupled with spiralling material costs, and the underperformance of other HSR lines have put most of the new construction on hold.

China is now planning to develop the world's largest HSR network with the aims; (1) relieve both passengers' and freight demand's pressure on its overcrowded existing rail system; (2) improve transportation connections between the country's different regions; (3) enhance the economic growth of less developed regions. China is also upgrading its existing lines and building new dedicated electrified lines. It is proven as in 2008, China's government announced plans to have approximately 16,000 km of high speed lines (including both upgraded existing and new dedicated electrified) in operation by 2020. As of 2014, China's HSR system was the longest in the world with 9,500 km in length.

In Indonesia, recently a few months of debate and media circus have halted the 143 kilometers of HSR construction. This was due to various policymakers, business stakeholders, and representatives from NGOs challenge over the project's feasibility. The multi-billion-dollar question now is whether the economic cooperation between Indonesia and China, two countries with strikingly contrast political system, would prosper. If the economic cost was the only concern, the Indonesian government's decision to grant China the responsibility of building the Jakarta-Bandung HSR project is justifiable.

This HSR construction is required needed due to the high demand of this nation, the government shall have the innovation to on high demand and needs of mass transportation in serving the nation community. As these projects become the key strategic and long term services for the nation. And of course, these innovation massive services becoming the key strategic issue in this recent decade, due to the technology development and society needs and demand [8]. Changes and demands in the global situation cannot be stopped; consequently, any nation shall prepare better service management for its people. The environments of the organizational and technological factors are creating a highly competitive business environment in in order giving services towards their customers respectively [9].

3. METHODOLOGY

This research combined quantitative and qualitative methods. The quantitative method used a Life Cycle Cost (LCC) secondary data analysis. It will be carried out as means of the success factor process used in this research that takes into account initial implementation in Asia and Europe, as well as operational and maintenance for HSR network development. In the qualitative method, participatory action research was conducted through in-depth interviews. These interviews involved a minimum of three persons from the Ministry of Transportation, including academics and practitioners. The interviewers were selected to represent High Speed Train development expertise, due to the limited number of respondents with knowledge about detailed elements of the HSR systems. The process of this research started with the identification of problems and development potential embedded within the project. Population levels and obstacles related to technical difficulties were determined in order to identify optimum routes during the HSR network development.

3.1. HSR Development as the Massive Strategy Services

The studies from a number of the country of the world have proven that the government's Strategic direction is to improve the country as services and transport hub. The train passengers, this is a very ideal means of transportation especially when integrated well with other rail transportation systems and other modes of interconnected transportation. it can be proved in developed countries like Japan, Europe and America where trains are the preferred means of transportation, certainly because they are more flexible, more fixed schedules, less formalities, such as check in, security checks, and ease of interfacial transfers. This should be the stakeholder's concern to be realized for the convenience of the user to become a reality, so for the individual movement, this train will increase the speed and convenience.

Table 2 City's Population Growth in Java Island

Rank	City	Population (2014)	Rank	City	Population Growth (%)
1	Jakarta	10,200,000	1	Surabaya	6.48
2	Surabaya	3,400,000	2	Purwokerto	4.17
3	Tangerang	3,000,000	3	Tuban	2.72
4	Bandung	2,600,000	4	Jepara	2.34
5	Bekasi	2,500,000	5	Cirebon	2.19
6	Karawang	2,288,254	6	Pandeglang	2.18
7	Cirebon	2,223,089	7	Bekasi	2.17
8	Indramayu	1,900,000	8	Bandung	2.08
9	Cilacap	1,750,000	9	Pamanukan	2.06
10	Grobogan	1,550,000	10	Pamekasan	2.01

By considering major cities and their populations in Java Island in the line of HSR plan development, further route analysis was performed to consider targeted demands, thus creating optimum route selections. As shown in Table 2 the data is retrieved from Statistics Indonesia (2014), to rank those cities based on population and their projected population growth [10].

3.2. Fiscal Evaluation of Worldwide HSR Systems

There are many different costs to plan, construct, operate and maintain the HSR line. Capital costs include the construction of track including the siding and terminal stations, and the train control system and the purchasing of the train vehicles. The operating costs include expenditures needed to run the trains every day. These include costs such as employees and the power source. Maintenance costs are the funds expended to keep the train operating correctly. Planning costs are the buffer costs that need to be included to counter against inflation, minor changes in scope and unexpected occurrences such as the discovery of historical artefacts. All HSR has each of these four costs. The following tables detail each of these costs. But due to the limited number of pages, this paper displays only two tables. Table 3 explores HSR capital costs for the most popular lines with available data. As shown in the table, capital costs vary significantly among different lines. The line constructed before 1990 such as Tokyo–Shin Osaka, Hakata–Shin Osaka and Paris–Lyon, built when land prices were lower, had lower construction costs.

Asian's construction costs are generally lower than European. China's HSR with a great number of viaducts and tunnels and a maximum speed of 350 km/h has an average capital cost of about US$19–21 million per km. On the other hand, the cost of HSR construction in Europe which has a design speed of 300 km/h or above is calculated to be of the order of US$25–39 million per km.

Table 3 Capital Cost of High Speed Rail

HSR line	Constructio n Cost (billion)	Length (km)	Cost per km (million)
Tokyo–Shin Osaka	0,92	515	1.8
Hakata–Shin Osaka	2,95	554	5.3
Tokyo–Shin Aomori	11,02	675	16.3
Tokyo–Niigata	6,69	301	22.2
Paris-Lyon (Southeast)	3.85	409	9.4
EAST Strasbourg	2.75	106	25.9
BPL Brittainy	4.51	182	24.8
CNM Nimes–Montpellier	2.46	80	30.8
Sud Europe Atlantique	10.67	303	35.2
Cordoba–Malaga	4.18	155	27
Madrid–Barcelona–Figueras	21.72	749	29
LGV East	9.30	300	31
Madrid–Valladolid	6.90	177	39
Shijiazhuang–Zhengzhou	7.47	355	21.0
Guiyang–Guangzhou	16.09	857	18.8
Jilin–Hunchun	6.74	360	18.7
Zhangjiakou–Hohhot	5.88	286	20.5

Aside from the minor cost of man power, HSR unit cost in China is affecting by various other factors. At a program level, the declaration of a convincing medium term plan for 10,000 km of HSR in China over a period of 6-7 years energized the construction and equipment supply community to increase the speed of build capacity and apply the innovative techniques to take advantage of very high work volume related to HSR construction. This has led to minor unit costs as the result of the development of competitive multiple local sources for construction such as earthworks, bridges, tunnels, EMU trains, etc. that adopted mechanization in construction and manufacturing. Furthermore, large volumes and the ability to amortize capital investments in high-cost construction equipment on a number of projects contributed to the lowering of unit costs [11].

It is not a coincidence that the two most fiscally successful lines have the two lowest construction costs per km. Typically the first HSR line a country builds makes the most economic sense. Politicians then place pressure on builders to construct additional lines that make less financial sense. However, due to the high capital costs and the technically challenging, all but three HSR lines require significant subsidies. Even when revenue covers capital costs or operating and maintenance costs, it rarely covers both. Table 4 examines a summary of the total costs for a theoretical line in Europe. In general, the maintenance of infrastructure and tracks represents 40-67% of total maintenance costs, whereas the signalling costs comprise between 10-35% of the costs in HSR.

The relative weight of the electrification costs makes up the third major cost component. These estimated costs are quite far from the China's proposal. However, the theoretical line as displays in Table 4 has much higher distances than are proposed by the China and Indonesian's consortium. A study from the World Bank office in Beijing shows that the construction of China's high speed railway has a rather similar infrastructure unit cost of about US$17-21 million per kilometre, excluding land, rolling stock and interest during construction. It is lower than the cost of similar infrastructure in European countries such as France and Spain which is estimated to US$25-39 million for every kilometre, while in California, the United States, the expense stands at US$51 million.

Table 4 Estimated Cost of 500-Km HSR Line in Europe

	Cost per unit (000)	Units	Total costs (US million)**
Capital costs			
Infrastructure construction (km)	13,200 – 44,000	500	6,600 – 22,000
Rolling stock (Trains)	16,500	40	660
Running costs (p.a.)			
Infrastructure maintenance (km)	137	500	33.75
Rolling stock maintenance (Trains)	1,178	40	39.60
Energy (Trains)	1,168	40	39.27
Labour (Employees)	47	550	21.78

**Total cost assumes two tracks

In reality, China currently possesses the technical know-how to build the fastest and cheapest railway networks and a successful localization of manufacturing of its goods and components. The predicament faced by China's firms, however, is that building a railway network on their own turf and in Indonesia might be totally different.

4. FACTORS DETERMINING THE SUCCESS OF THE HSR

There are a number of factors that help determine the success of high speed rail. The first is population density near the rail station. Since HSR requires high urban densities, particularly those concentrated close to major stations, extending HSR to places without the ability or desire to encourage high densities is unlikely to be successful. Table 5 compares the population density of selected major Asian cities [12]. Both Indonesian cities are substantially less dense than their counterparts. Further, the urban area became more dispersed where metropolitan areas tend to consume more land for urbanization. The greater dispersion of population makes it difficult to concentrate as needed to operate HSR efficiently [13]. To compete with conventional trains and intercity buses, HSRs must depart frequently but they must also fill or nearly fill their seats to generate enough ticket revenue to cover their operating costs.

Table 5 Density of Selected Asian City

Asian city	People/km^2
Mumbai	32,400
Manila	15,300
Bandung	12,200
Delhi	12,100
Seoul	10,400
Jakarta	9,500

Connectivity of rapid public transport is the second major factor. In Tokyo and Seoul, the passenger can arrive at station and travel by metro or commuter rail to nearly all the destinations in the urban area. Bus ride may be necessary to reach one's final destination. Otherwise, both Jakarta and Bandung have not extensive public transport systems that could make seamless travel possible. And since public transport usage is one of the greatest indicators for rail success, ridership is important. However, in two of the metro areas, it is less than 30%. Contrast this with Tokyo where it is 60% and Seoul where it is 65%. Hence, this does not bode well for the success of high speed rail in Indonesian cities. Moreover, most European countries and Japan have substantially more rail network density than Indonesia as shown in Table 6. China itself has an 8.11 of rail network density, which is almost nine times lower than Japan. However, it still has almost ten times more rail network density than Indonesia.

Further, passenger train service in Europe and Japan and even China is substantially more integrated into modern life. Railways are more popular in those countries than in Indonesia. Many countries implemented high speed rail to relieve over-crowded conventional trains [14]. In addition, the research at neighbourhood and station-area scale indicates that significant transit trip generation rates from residential development proximate to rail stations, especially for systems and regions in which both housing and employment are found adjacent to transit. Empirically, the distance to transit varies case by case. In general, current planning practice recommends a 400 to 800 meters' radius as the pedestrian catchment area for transit service, representing a 5-minute walking distance [15]. In Indonesia, including Jakarta and Bandung, however, very rare metropolitan areas are sufficiently dense or have the extensive transit or urban bus systems to make transfer between different modes possible.

Table 6 Rail Network Density of Selected Country

Country	Rail network density (in m per km^2)	Length of the rail network (in km)	Size of the country (in km^2)
Germany	117.35	41,896	357,022
Poland	71.36	22,314	312,685
Japan	69.95	26,435	377,915
United Kingdom	67.54	16,454	243,610
Italy	65.47	19,729	301,340
EU	53.10	229,450	4,324,782
China	8.11	77,834	9,596,981
Indonesia	0.90	4,684	5,193,250

As data display in Table 6 Germany position take the highest of rail network density if comparing to a number of countries over the world, otherwise the Indonesia's rank is still far behind. The operation of Jakarta-Bandung HSR is claimed to provide positive benefits due to the growth people in West Java and Jakarta areas and also contribute by other community who come from other regions. The growth is triggered by the increasing number of available seat capacity due to the emergence of low cost carrier in Indonesia which accelerates the growth of passengers of the train transportation sector from year to year [16]. With this project, the economy of the community will be lifted and impact nationally towards gross product domestic (GDP). The government of West Java receive and share in the tax revenues and bring new economic points along the line. This is the opportunity for the government in preparing growth strategy for delivering massive transportation strategy. The organizations and the business industries which link to these services will face an additional challenge the requirement to innovate and adapted in with this success project. In accordance with that the sphere of organizational and managerial attention has expanded to incorporate both mainstream variables and an innovation capability to giving the best services [17]. The passengers as the main consumers who feel satisfaction is the passengers who already felt satisfied through the services offerings made and associated with their expectations [18]. The other impact of this project are the community of the stations and areas surrounding the HSR will experience increased activity and development as well as its economy, which will generate new opportunities for the real estate sector, hotel, and small and medium-sized trades. The urban and rural areas along this HSR route will also experience a balanced developmental impact.

5. CONCLUSION

It must be recognized that Indonesia lacks some of the variables that make high speed rail is successfully applied in other countries. For starters, Indonesia has neither the population density nor the land use regulations necessary to support the development of high speed rail. It lacks a pre-existing, successful passenger rail system, and far less on urban public transport usage than Tokyo and Seoul. Further, high speed rail cannot work in the absence of large urban populations clustered around city center's rail terminals and extensive public transport systems that allow passengers to easily complete their journeys. If those variables do not exist, travelers will not make the high speed rail as a transportation choice. However, if the economic cost was the only concern, the Indonesian government's decision to grant China, not Japan, the responsibility of building the Jakarta-Bandung bullet train project is justifiable.

With the existence of this HSR becomes free from traffic, the train also free the highway from traffic jam. If many people are switching to trains, the number of motor vehicles can be reduced significantly so that the road load becomes reduced. besides it will save time, cost-effective, space saving because HSR can carried a huge number of passengers, even exceeds the number of passenger's plane. Others are environmentally friendly as well as convenient mass transit, and safer than road. The train passengers will be more disciplined because they have to adjust the train schedule.

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