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Enhancing Passenger Volume for the Jakarta-Bandung High-Speed Rail: A System Dynamics Approach to Sustainable Regional Development

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ABSTRACT

The Jakarta–Bandung high-speed train (HST) project aims to enhance intercity connectivity between two major metropolitan regions in Indonesia, with anticipated benefits in mobility, economic development, and tourism. This infrastructure initiative is projected to create employment during both construction and operation phases. However, achieving the targeted ridership of 30,000 daily passengers remains a key challenge, particularly when compared to the current usage of conventional trains, which fluctuates between 10,000 and 14,000 passengers per day. This gap raises concerns regarding the long-term sustainability of the HST system. This study applies a system dynamics modelling approach to analyze various factors influencing passenger demand, including fare structures, service frequencies, travel time, and station accessibility. The model integrates feedback loops to capture the dynamic interrelations between policy interventions, transportation infrastructure, and land use. Simulation results reveal that demand is highly sensitive to seasonal variations, with peak travel periods occurring during mid-year and year-end holidays. Among the evaluated scenarios, the highest ridership is achieved when strategies such as integrated multimodal connectivity, optimized pricing, and tourism promotion are implemented. These findings highlight the importance of coordinated policy measures in enhancing system performance. The study concludes that a comprehensive, multi-sectoral approach is essential for achieving operational viability and long-term sustainability in high-speed train systems, particularly in emerging economies seeking to maximize infrastructure investments.

1. INTRODUCTION

High-speed train (HST) is a revolutionary form of transportation, facilitating markedly reduced travel duration, enhanced energy efficiency, and reinforced regional economic cohesion. Globally, HST frameworks are designed to function at velocities surpassing 250 km/h, underpinned by specialized infrastructure that guarantees operational efficacy and passenger safety [1]. HST systems incorporate advanced aerodynamic designs, propulsion systems, and braking technologies, allowing for higher speeds and enhanced safety. Dedicated tracks, characterized by minimal curves and gentle gradients, ensure a smooth travel experience. The main advantages include shorter travel times between major urban centers, improved energy efficiency, reduced emissions, and economic growth through enhanced connectivity.

The Jakarta-Bandung HST is a national strategic initiative focused on improving mass transportation and promoting regional development. Spanning 142.3 km from Halim to Tegalluar, this initiative stimulates the industrial, commercial, and tourism sectors while creating job and investment opportunities. Running parallel to the toll road on newly constructed tracks, HST plays a role in modernizing transportation systems and expanding economic centers. Longitudinally, Jakarta-Bandung HST serves as an essential component of the larger Jakarta-Surabaya train network, establishing a direct connection between Jakarta and Bandung. The Jakarta-Bandung HST will pass through eight different regencies and municipalities, including Jakarta, Bekasi City, Karawang Regency, Purwakarta Regency, Padalarang Regency, Cimahi City, and Bandung Regency. The primary line covers a total length of 142.3 kilometers, with various structural configurations of 16.82, 23.58, 19.2, and 82.7 kilometers of tunnels (11.82%), embankments (16.57%), cuttings (13.49%), and elevated structures (58.12%), respectively.

The successfully inaugurated stations are Halim, Padalarang, and Tegalluar. Therefore, this research will focus on examining the regional development and economic growth associated with the stations in Bandung Regency and West

Bandung Regency, with a comparative analysis. Achieving the target of 30,000 daily passengers is seen as a significant challenge, specifically compared to conventional train ridership which ranges from 10,000 to 14,000 passengers per day under standard operational conditions. This scenario poses a sustainability challenge for national initiatives. However, the most significant modal shift occurs among users of conventional train services in the Jakarta–Bandung corridor, with 81.02% showing a preference to switch to HST under improved service conditions [2].

The following discussion presents an overview of the monthly ridership statistics for HST service projected through January 2025. Currently, the number of passengers remains below the established target. Therefore, this research examined the broader socioeconomic and spatial impacts of HST systems by stating the potential to alter regional growth patterns, shift population and employment dynamics, and reshape accessibility landscapes. For instance, areas served by the Shinkansen in Japan experienced higher growth rates but was influenced by other local factors. Even though HSTs can trigger development around new stations, this effect is not automatic and depends on complementary strategies and connectivity [3]. Within this context, the study further investigates how HST influences both passenger growth and land use transformation, especially in terms of accommodations. Using dynamic modeling, it measures temporal changes in passenger numbers, forecasts future trends, and evaluates the development of hotels and apartments near HST stations. The findings underscore the need for sustainable regional planning in cities like Jakarta, Bandung, and Surabaya, where patterns of urban expansion and accommodation development are increasingly shaped by the presence of HST infrastructure.

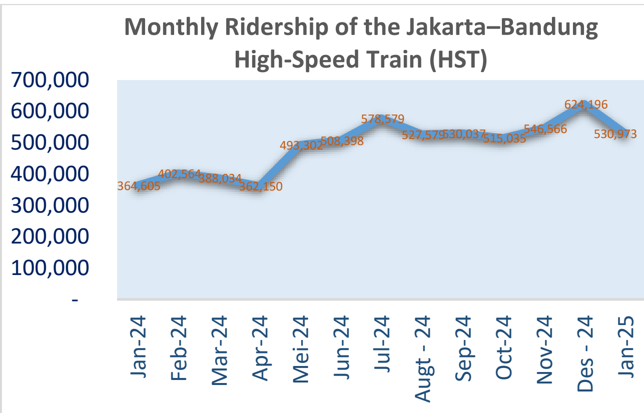

Figure 1. Monthly Jakarta-Bandung HST ridership (Jan. 2024–Jan. 2025)

Source: Kereta Cepat Jakarta-Bandung (KCJB)

Figure 1 presents the monthly passenger volume of the Jakarta-Bandung HST, managed by PT Kereta Cepat Jakarta-Bandung (KCJB). The data show a general upward trend in ridership throughout the observed period, with seasonal variations. Passenger numbers reached the highest levels in the middle and toward the end of 2024, followed by a modest decline at the beginning of 2025.

2. LITERATURE REVIEW

HST represents an important development in Indonesia since the initiative significantly reduces travel time, stimulates regional economic activity, enhances inter-connectivity, and supports the infrastructure-focused strategy outlined in the National Medium-Term Development Plan (RPJMN) 2020–2024, as formalized through Presidential Regulation No. 18 of 2020.

An alternative examination shows that the high-speed train project in Indonesia possesses the capacity to markedly enhance transportation efficiency, catalyze economic expansion, and promote urban development, contingent upon the effective application of the insights garnered from other nations [4].

A significant area of inquiry has investigated the influence of HST on economic advancement, obtaining critical insights into the factors that shape passenger preferences, methodologies for stimulating demand, and the extensive repercussions on regional progress. These investigations emphasize the significance of dynamic systems in enhancing HST operations. The methodologies include surveys, statistical analysis, econometric modeling, case research, comparative analysis, system dynamics modeling, and simulations. Collectively, the strategies provide a holistic comprehension of the elements contributing to the success of HST.

Economic growth and development within Indonesia can be improved by enhancing market accessibility for enterprises located in Jakarta, Karawang, and Bandung, potentially elevating collective income by 12-18%. This may contribute to a 0.4% increase in real GDP, particularly during the construction phase. However, the initiative also includes certain risks, including potential job losses in traditional industries and complications associated with land acquisition, which can adversely influence overarching success and ramifications for urban development [5].

The demand for HST passengers traveling from Jakarta to Bandung is anticipated based on the growth of GDP per capita, the expansion of the manufacturing sector, and the real estate market. The progression of regional macroeconomic indicators is largely consistent with the national averages. The economic growth scenario for Jakarta will be extrapolated using the national GDP growth rate to assess HST passenger demand.

All critical parameters essential for the operational success must be harmonized with the established frameworks to attain the anticipated economic growth objectives. An important parameter is the volume of passengers scrutinized to ascertain the level of expectations. This research investigates methods to augment passenger volume and assesses the implications for regional development, particularly concerning land utilization.

Research contribution

The Jakarta–Bandung HST, spanning 143 kilometers, marks a significant milestone in the transportation infrastructure, representing the first operational HST system within the inaugural year of service. Even though the corridor is relatively short by global standards.

HST systems show optimal performance at distances of approximately 150 kilometers, below which road-based modes such as private cars and intercity buses tend to remain more competitive. This threshold is influenced by factors such as station location, access time, and the total door-to-door travel experience. According to empirical results in China, HST services attract significant modal shifts and generate new passenger demand when distances exceed 150 km, particularly on routes connecting medium-to-large cities. The Beijing–Tianjin and Tianjin–Jinan corridors provide clear examples of successful HST operation within the minimum distance benchmark [6]. These distance ranges effectively enhance time-space compression, a key factor in boosting economic growth. Consequently, the influence on passenger numbers is assessed to ascertain whether it fulfills the established targets, as well as to analyze its ramifications on regional development, particularly concerning alterations in land utilization and the capacity of land to sustain such changes.

3. MATERIAL AND METHODS

There are various methodologies for modeling the relationship between the increase in HST passenger numbers and land use planning for accommodations. An effective approach is dynamic system modeling, which addresses the interplay between rising HST passenger volumes and land use preparation.

Dynamic system analysis of transportation infrastructure includes understanding, modeling, and evaluating the interactions among various components. This analysis considers the temporal effects on variables that influence the performance and effectiveness of the infrastructure. System dynamics is a flexible methodology well-suited to analyzing complex, interrelated challenges in infrastructure and spatial planning. Originating from Forrester's work at MIT in the 1950s, the concept captures feedback relationships among system components and supports simulation-based scenario analysis. In Indonesia, this method has been applied to model urban railway demand. A system dynamics model for the Jabodetabek commuter network identifies future passenger growth, infrastructure needs, and safety strategies offering a relevant foundation for assessing HST development and the land use implications [7].

This dynamic analysis aims to provide a comprehensive understanding of the impact of HST on passenger volumes over time, as well as detailed insights into the ongoing changes in land use for accommodations and resource distribution. The goal is to formulate recommendations that optimize the benefits derived from HST development by integrating land use and transportation planning, supported by projections and scenario analyses to aid urban planning and policy formulation.

The system is particularly useful for analyzing passenger demand for HST to capture the complex, non-linear interactions between decisions made by various stakeholders and effects on ridership. System dynamics (SD) model incorporates actual operational data, allowing for simulations to evaluate the effects of pricing, seat availability, maintenance, and service quality on demand throughout different stages of the life-cycle. This comprehensive method helps identify optimal management strategies and enhances coordination between public and private stakeholders. Furthermore, system dynamics model estimates that HST ridership in Indonesia can reach 30,000 passengers per day, showing the potential impact on land carrying capacity.

4. SYSTEM DYNAMIC MODEL

Dynamic system analysis aims to provide a comprehensive understanding of the effect of HST on passenger volumes over time, with detailed insights into land use changes related to accommodations and resource allocation. This analysis seeks to develop recommendations for maximizing the benefits of HST development through the integration of land use and transportation planning, supported by forecasts and scenario analyses to assist urban planning and policymaking. Additionally, the conceptual causal cycle of system dynamics model, which centres on HST transportation between Jakarta and Bandung, shows substantial impacts on hotel occupancy rates in Bandung. Several key objectives are outlined for using dynamic system method, including: (a) simulating the volume of Jakarta-Bandung HST passengers generated from demographic trends, (b) executing diverse scenarios to enhance the number of Jakarta-Bandung HST passengers, (c) modelling the residual carrying capacity of the Jakarta-Bandung HST system, and (d) simulating the remaining land capacity designated for accommodation purposes. This dynamic interaction is visualized in the Causal Loop Diagram (CLD). Figure 2 shows the limitation posed by Jakarta-Bandung HST capacity (Loop B1) and the constraint from limited land availability for accommodations (Loop B2).

a. Loop B1: Population growth leads to an increase in the number of railway users. A portion of these railway users will choose to use the Jakarta-Bandung HST. As the number of Jakarta-Bandung HST users increases, the remaining HST capacity will decrease to a maximum capacity of 30,000–60,000 passengers per day. Meanwhile, the current realized number is around 10,000–20,000 passengers per day.
b. Loop B2: Population growth will lead to an increase in the number of passengers. These passengers require accommodation services, such as lodging and other related services, which require land. The available land is around 4,000 hectares, with 5% allocated for accommodation purposes.

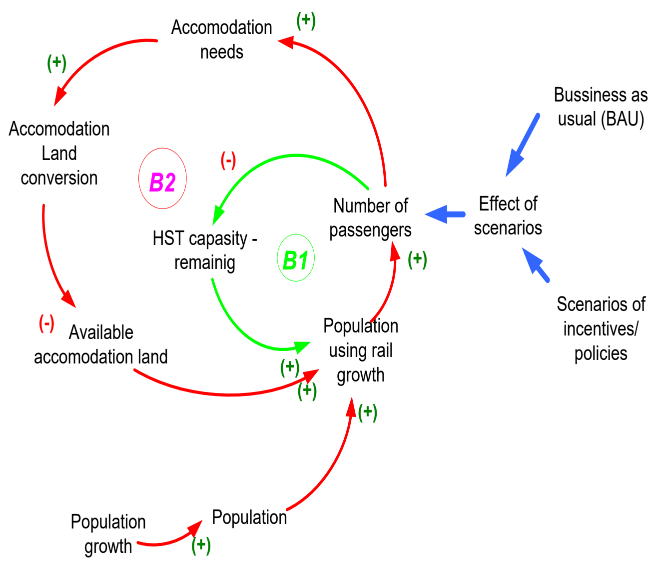

Figure 2. Causal Loop Diagram (CLD)

4.1 Model implementation

Model implementation includes simulating monthly data from January 2024 to January 2034, with the period from January 2024 to December 2025 serving as the baseline for calibrating projections. The population projections utilized in this study are derived from comprehensive regional statistical data for the Jakarta Metropolitan Area (Jabodetabek), as presented in Table 1, and for Bandung and its surrounding regions, as detailed in Table 2. Regional population growth is a primary driver for passenger volume forecasts, stating the influence of urban dynamics on transportation needs. Simultaneously, HST passenger demand is informed by operational records from the Jakarta–Bandung Whoosh service. Travel patterns, such as annual passenger movements between Jakarta and Bandung, are sourced from the Ministry of Transportation's Origin-Destination (OD) survey, providing a critical basis for understanding baseline travel behaviors and future projections, as presented in Table 3.

a. Jakarta and the surrounding areas: Includes all cities/regencies in DKI Jakarta, Bogor City and Regency, Depok City, Tangerang City and Regency, and South Tangerang City.
b. Bandung and the surrounding areas: Includes Bandung Regency, West Bandung Regency, Bandung City, and Cimahi City.

Table 1. Population data for Jakarta and surrounding areas (in thousands)

Region	2020	2021	2022	2023	2024
DKI Jakarta	10.560	10.620	10.680	10.740	10.800
Bogor Kab	5.566	5.596	5.627	5.682	5.737
Bogor Kota	1.050	1.060	1.070	1.080	1.090
Depok Kota	2.330	2.350	2.370	2.390	2.410
Tangerang Kab	3.300	3.320	3.340	3.360	3.380
Tangerang Kota	2.185	2.240	2.337	2.481	2.508
Tangsel Kota	1.748	1.768	1.788	1.808	1.828
Bekasi Kab	3.600	3.620	3.640	3.660	3.680
Bekasi Kota	2.450	2.470	2.490	2.510	2.530
Total	32.790	33.044	33.342	33.711	33.964

Source: Statistical Data of Indonesia 2024

Table 2. The population data of Bandung and its surrounding areas (in thousands)

Region	2020	2021	2022	2023	2024
Kota Bandung	2,444,160	2,461,410	2,484,150	2,506,600	2,528,160
Kab Bandung	3,623,790	3,652,400	3,687,250	3,721,110	3,753,120
Kab Bandung Barat	1,788,340	1,808,420	1,834,230	1,859,640	1,884,190
Kota Cimahi	568,400	574,450	582,650	590,780	598,700
Total	8,424,690	8,496,680	8,588,280	8,678,130	8,764,170

Source: Statistical Data of Indonesia 2024

Table 3. Travel patterns between Jakarta and Bandung

Trip		2018	2023	2028	Quantity
Jakarta	Bandung	20.017.125	21.041.351	22.271.919	Jakarta
Bandung	Jakarta	21.392.566	22.567.966	23.981.871	Bandung
Jakarta	Bandung	1.668.094	1.753.446	1.855.993	Jakarta
Bandung	Jakarta	1.782.714	1.880.664	1.998.489	Bandung
Jakarta	Bandung	54.841	57.648	61.019	Jakarta
Bandung	Jakarta	58.610	61.830	65.704	Bandung

Source: Ministry of Transportation

Table 4. The passenger growth scenario settings

Sce0	Sce1	Sce2	Sce3	Sce4	Parameter
0	5	0	0	5	Weekend sensitivity
0	0	10	0	10	Ticket prices based on time
0	0	10	0	10	Fuel subsidy
0	0	30	0	30	Tourism event
0	0	0	10	10	Bandung feeder
0	0	0	25	25	Jakarta feeder

Notes: Sce0: Business-as-usual condition, with all parameters set to zero. Sce1: Passenger growth stimulated by increasing public holidays. Sce2: Implementation of a time-based ticket pricing system, fuel subsidies, and promotion of tourism events. Sce3: Enhancement of feeder systems in Jakarta and Bandung. Sce4: Comprehensive combination of all interventions.

4.2 The scenario

Several policy intervention scenarios have been developed to enhance passenger growth forecasts. These scenarios focus on levers such as promoting tourism events, introducing time-based ticket pricing, adjusting fuel subsidies, and strengthening feeder transportation connectivity to and from HST stations. Scenario evaluations were informed through consultations with experts in transportation, regional development, tourism, and public policy. These expert inputs were utilized to assign optimal and logically consistent scores to each scenario used in the system dynamics simulation, as detailed in Table 4. Each intervention is expected to influence travel behaviour differently, and the combined impacts are explored through dynamic scenario simulations.

4.3 Stock flow diagram

In the context of system dynamics analysis, the model is divided into population, passenger demand, passenger volume metrics, policy scenarios, and land availability. The population assumption is based on five key cities and the surrounding areas of Jakarta and Bandung considered representative of the region. HST passenger data is sourced from monthly records of HST Jakarta-Bandung, covering the period from January 2024 to January 2025.

The interrelationships among the variables shown in the CLD are translated into a system dynamics program, as shown in Figure 3.

Simulation of policy scenarios enables urban planners and policymakers to assess the potential effectiveness of different interventions and combinations. This method allows for dynamic evaluation of policy changes on passenger volumes and operational sustainability.

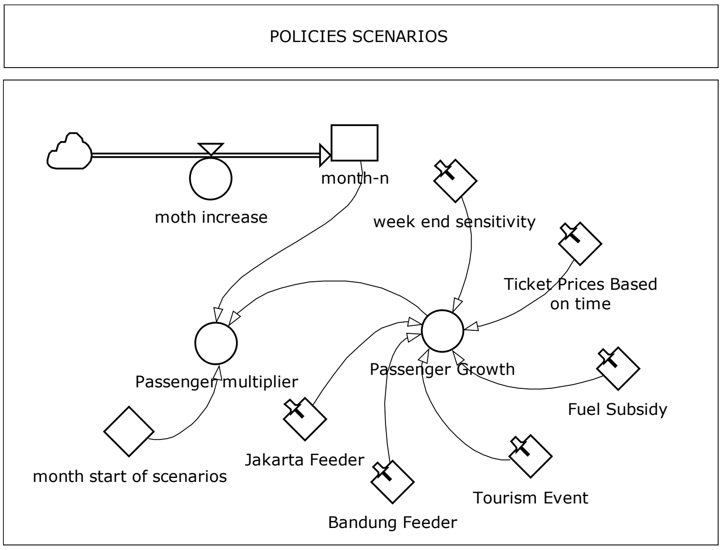

Figure 3. Policy scenario illustration

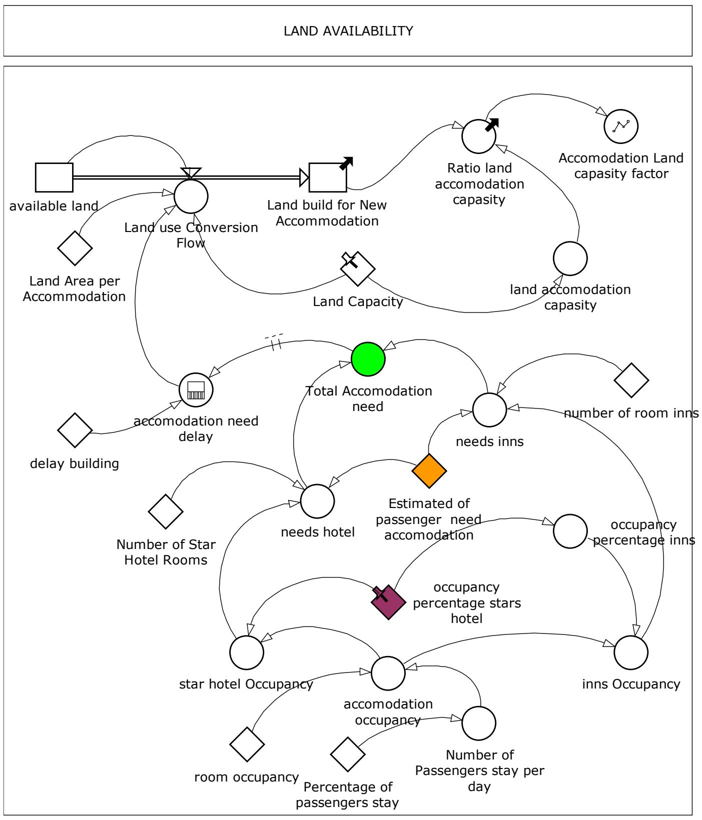

Figure 4. Land availability forecast

Land availability, a critical constraint supporting the growth of accommodation services related to increased HST passengers, is also modelled. Land allocation projections of ±4,000 hectares with an estimated 5% allocated for accommodation are visualized in Figure 4, emphasizing the spatial limitations considered in urban development plans. These integrated components establish a robust system dynamics framework, enabling the forecasting of future impacts of HST on passenger volumes and land use. This comprehensive model provides evidence-based support for more effective infrastructure planning, urban policy design, and sustainable regional development.

Together, these integrated components establish a robust system dynamics framework, enabling the forecasting of future impacts of HST on passenger volumes and land use. This comprehensive model provides evidence-based support for more effective infrastructure planning, urban policy design, and sustainable regional development.

5. RESULTS

The simulation was carried out monthly from January 1, 2024, to January 1, 2034, spanning a total of ten years. The time frame from January 2024 to January 2025 is used as the baseline data.

5.1 Passenger simulation

Figure 5 presents the monthly passenger projections for the Jakarta–Bandung HST under five distinct policy and operational scenarios (Sce0 to Sce4) over the period from December 2024 to December 2026. These scenarios incorporate varying assumptions concerning fare policies, service frequency, station accessibility, and tourism-related demand.

The simulation reveals clear cyclical patterns in ridership, with significant peaks during mid-year (June–July) and end-of-year (December), aligning with national holidays and seasonal travel surges. Among the five scenarios, Sce0, which represents a baseline or minimal-intervention strategy, consistently yields the lowest passenger volumes. In contrast, Sce4, which integrates multimodal connectivity, optimized fare structures, and tourism promotion, achieves the highest projected ridership, reaching nearly 900,000 passengers per month by the end of 2026.

A decline in ridership was consistently recorded in the early months of 2025 and 2026, which is presumed to have been caused by a reduction in travel activity following the holiday season. The increasing gap between Sce0 and Sce4 over time highlights the cumulative effectiveness of policy interventions in boosting demand. The simulation outcomes thus support the proposition that comprehensive, multi-pronged strategies are critical to achieving long-term sustainability goals for the HST system.

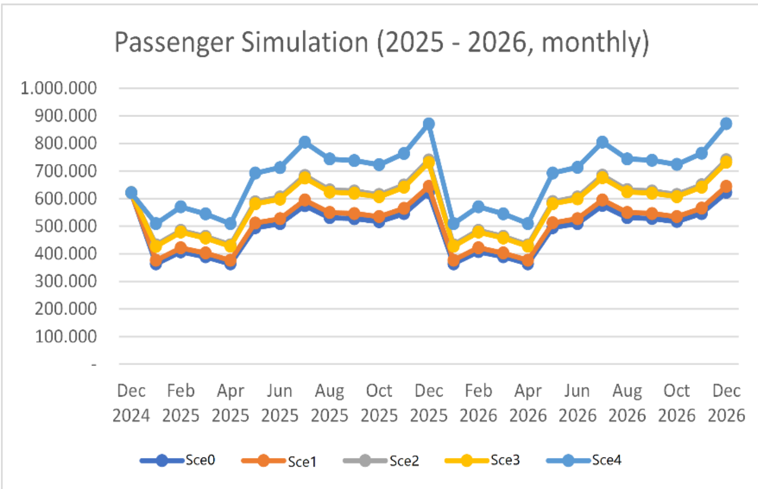

Figure 5. Passenger simulation

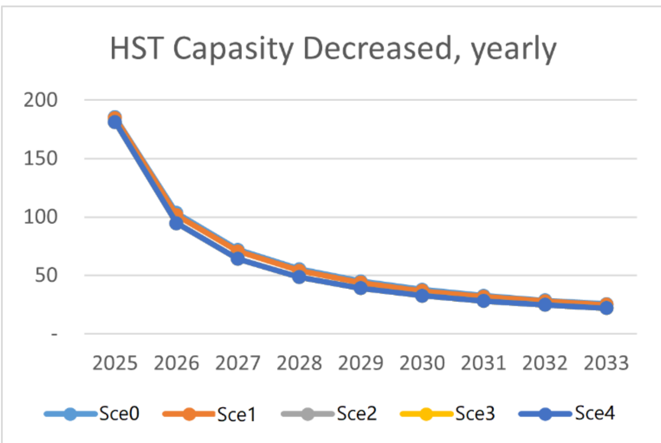

Figure 6. HST capacity

Specifically, peak ridership is driven by three key seasonal and behavioral factors:

(1) Year-end holiday season:

The festive periods of Christmas and New Year draw many individuals to travel for family gatherings, leisure activities, or returning home. December coincides with a lengthy school holiday break, further increasing travel demand.

(2) Tourism factors:

Bandung is acclaimed as a top tourist destination, particularly during the peak holiday season that concludes the year. The influx of tourists contributes significantly to the increased number of Jakarta-Bandung HST in service passengers.

(3) Community travel patterns:

In other months, travel is primarily routine for work or business to maintain a relatively steady demand. However, December sees an increase in non-routine travel, including leisure trips and homecoming journeys. Purba and Purba [8] reported that seasonal spikes are critical for operational viability. Broader evidence also confirms December as a peak mobility month [8, 9]. The target was not met from January to April, even though interventions were put in place.

As shown in Figure 6, the projection decreases in Jakarta-Bandung HST capacity utilization across multiple intervention scenarios (sce0–sce4). The occupancy rate of the HST system is expected to decline over the next decade with improvements in service conditions. This trend suggests diminishing efficiency in capacity usage, particularly under the business-as-usual scenario (sce0). A higher capacity utilization rate reflects more optimal and efficient operation of HST services. Therefore, sustained decline signals the need for stronger policy and government interventions to maintain or improve ridership levels. Despite interventions, utilization efficiency may decline unless capacity is matched with demand strategies.

5.2 Land requirements for accommodation

The increase in the number of passengers using the Jakarta-Bandung HST could lead to a greater demand for hotel accommodations for several reasons, namely more tourists visiting the area, increased business travel, a rise in events and conventions, and shifts in travel behavior. Tourists who previously chose to take day trips may decide to stay overnight to enjoy the city better, resulting in a higher need for lodging options with shorter travel times (Figure 7).

5.3 Land use capacity

As shown in Figure 8, the cumulative impact of increased lodging demand leads to a measurable reduction in available land capacity for accommodation. However, this reduction remains within acceptable limits, and the remaining land is sufficient to support projected demand for at least the next 10 (ten) years, assuming appropriate spatial planning and development controls are maintained.

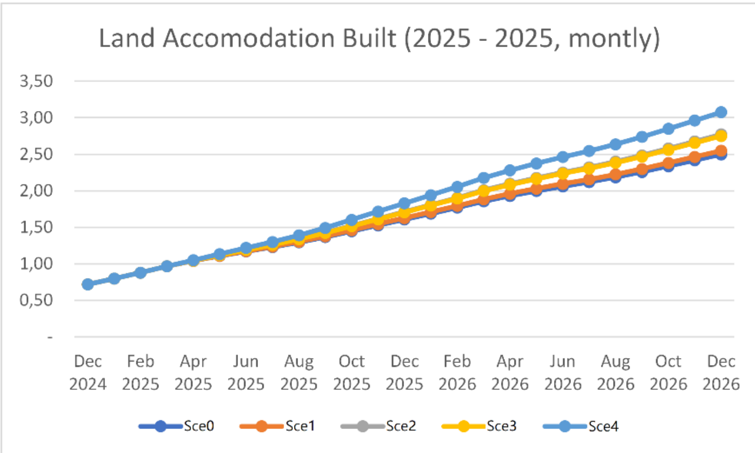

Figure 7. Land for accommodation

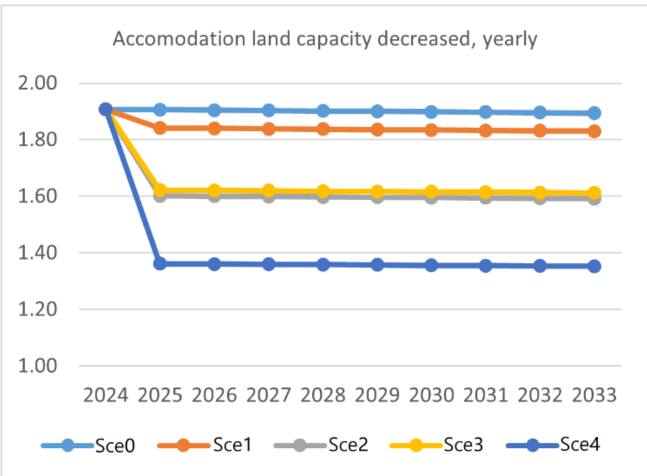

Figure 8. Land capacity for accommodation

5.4 Model validation

Model validation in system dynamics ensures an accurate representation of real-world behavior and reliable results. Several theoretical methods are commonly used for model validation in system dynamics. The validation results of the model calculation using the Mean Absolute Percentage Error (MAPE) method obtained a value.

$$\text{MAPE} = \frac{1}{n} \times \frac{\sum(abs(Xm - Xd))}{Xd} \times 100\% \quad (1)$$

where,
Xd = data;
Xm = result of simulation;
n = number of data.
For the criteria:
$MAPE$ < 5%: Very accurate;
5% < $MAPE$ < 10%: Accurate;
$MAPE$ > 10%: Not accurate.

The outcome of this model is 0.48 or 4.8%, confirming model accuracy and supporting its use in planning (Figure 9).

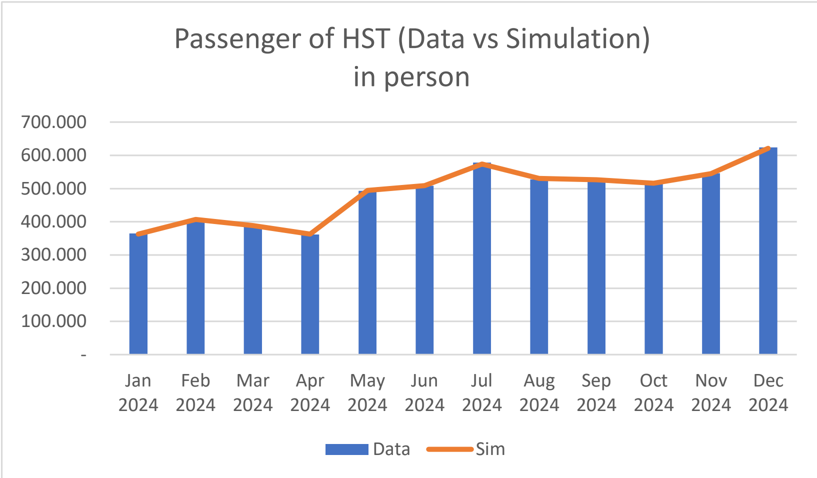

Figure 9. Passenger validation model

6. DISCUSSION

A system dynamics simulation shows that passenger growth on the Jakarta-Bandung HST corridor peaks in December, primarily due to holiday-related travel. However, from February to April, ridership remains low, posing challenges to the government's operational and financial targets. To address fluctuations and balance with long-term development goals, strategic interventions such as service improvements, seasonal pricing, and enhanced feeder connectivity are essential.

Recent modeling efforts show that time-sensitive pricing, formulated through a bi-level optimization paradigm, facilitates a dual objective, namely the maximization of operator revenue alongside the minimization and equalization of passenger costs, redistributing demand from peak to off-peak time-frames and enhancing overall system efficiency [10]. Travel behavior research comparing HST and road passenger transport (RPT) in selected Chinese cities reported that passengers prioritized speed, comfort, and punctuality when choosing HST. Meanwhile, fare affordability and safety were more influential for RPT users. Using a logit model, the analysis shows that enhancing RPT's comfort, safety, and fare structure can significantly raise the attractiveness, with income levels and regional preferences playing a crucial role in shaping travel mode decisions [11].

Empirical evidence based on difference-in-differences estimation supports the assertion that HST development stimulates tourism, specifically in nodal cities integrated within national networks, increasing visitor flows and local revenues [12, 13]. A comparative research confirms that passengers prefer HST over air travel when service attributes such as the speed between HST and air travel and consumer behavior are emphasized [14]. In this context, tiered and adaptive pricing structures, combined with strategic seat allocation models, have proven effective in strengthening financial viability and contributing to potential revenue [15, 16].

This research shows that enhancing multimodal accessibility, particularly by increasing the availability of feeder services such as buses, subways, and regional railways, has a more significant impact on HST ridership than reducing transfer times or improving service frequency. The result emphasizes that the quantity of supporting facilities around HST stations plays a critical role in improving first- and last-mile connectivity, promoting greater use of HST services [17]. The research on China's Beijing–Shanghai corridor and Japan's Shinkansen network report that managing peak-period demand in HST systems requires more than speed enhancements. Reliable, cost-effective, and well-integrated transport particularly through frequent short-distance services and seamless last-mile connectivity proves more effective in increasing ridership and sustaining tourism flows during high-demand periods. Integrated feeder systems and local accessibility are essential to optimize the benefits of HST during peak time [18, 19]. Additionally, accessibility research shows that access travel time to HST stations strongly shapes network utility and perceived attractiveness [20]. Based on the results, this research outlines two strategic government policies aimed at maximizing HST operations and improving regional development to manage passenger demand and prepare land for future needs.

6.1 Passenger demand management

Building on the preceding system dynamics simulation and empirical results, the effectiveness of Jakarta–Bandung HST operations depends significantly on the management of passenger demand. Addressing seasonal fluctuations, improving station accessibility, and balancing service offerings with user preferences are critical to sustaining ridership growth. This section outlines five interrelated strategies that form a coherent policy approach by improving feeder connectivity, implementing flexible pricing, rationalizing fuel subsidies, responding to temporal travel patterns, and balancing land use with transit infrastructure.

6.1.1 Enhancement of feeder services

A key determinant of HST ridership is the quality of feeder access. The use of peripheral stations can lower infrastructure costs and improve scheduling flexibility but creates challenges in accessibility. Lengthy and costly access or egress from city centers may offset the benefits of low fares and deter potential users. Strengthening feeder connections between HST stations and urban transport networks is essential to enhance convenience, increase ridership, and ensure the overall effectiveness of low-cost services, particularly for price-sensitive passengers and families [18, 21]. These patterns reinforce the importance of feeder integration, particularly for promoting non-commuter and tourism-related travel.

6.1.2 Ticket pricing based on time and tourism events

A review of China's HST pricing practices confirms the effectiveness of dynamic and time-sensitive pricing strategies in improving revenue and capacity utilization. By integrating dynamic pricing with seat allocation, this research shows that adjusting fares based on demand elasticity, travel time, and seasonal variations such as holidays or peak travel periods can increase revenue by 4.95% compared to fixed pricing. The results report that pricing strategy is as critical as physical connectivity in shaping traveler behavior, optimizing seat occupancy, and achieving operational efficiency [22]. Within the Beijing-Shanghai corridor in China, operators have shifted from static to dynamic fare structures adjusted in line with seasonal variations, departure times, and service classes [23]. These methodologies show the advantages of adaptive pricing, particularly in contexts characterized by high demand.

Pricing strategies ought to be informed by traveler segmentation when applied to the Jakarta-Bandung corridor. Variations in travel behavior and willingness to pay are evident across user groups. Business travelers prioritize time savings and seamless connectivity, while leisure passengers are more responsive to fare levels. These differences allow differentiated pricing models to manage demand and maximize revenue potential [24]. Research emphasizes the role of inter-urban train in improving suburban economic development, which requires effective management of environmental capacity. The 2024 West Java Province Tourism Market Analysis shows that 53%, 23%, and 24% of Whoosh passengers travel for leisure, business, and commuting or education, respectively. Even though 63.7%, 57.9%, and 66% of domestic travelers opt for private vehicles, trains, and HST, focusing on affordability and efficient pricing options can facilitate a more uniform distribution of demand across the week. Pricing evolves into a proactive mechanism for demand management and congestion alleviation when integrated with strategic marketing initiatives surrounding tourism events. Similarly, urban areas connected to HST network have experienced a significant increase in tourism activity, with revenue increasing by 22% and tourist arrivals rising by 38% compared to centers without HST access [25].

6.1.3 Fiscal incentives and fuel subsidy reduction

To further promote a modal shift towards HST travel, the consideration of fiscal disincentives aimed at reducing private vehicle usage through the minimization of fuel subsidies is warranted. In addition to the environmental advantages, such policies re-calibrate cost-benefit analyses in favor of mass transit systems. According to Banister [26], fiscal instruments play a crucial role in facilitating inter-modal integration. Complementary incentives, including fare reductions for off-peak HST services can enhance utilization rates and preserve affordability for flexible traveler demographics. The effectiveness of policies is maximized when executed to create a synergistic effect through behavioral nudges and pricing efficiency.

6.1.4 Weekend sensitivity

Seasonal and temporal variations in ridership necessitate strategic management to optimize service delivery. Passenger demand peaks on weekends, primarily due to leisure travel and extended holidays. Furthermore, government initiatives and major events, such as collective leave days and international concerts, enhance ridership. Simulations predict a 5% rise in travel due to holidays and a 30% increase from events in Jakarta and Bandung, which significantly impacts HST demands.

6.1.5 The impact of land use planning

Beyond immediate operational considerations, the long-term viability of HST systems depends on strategic land use planning in proximity to stations. HST infrastructure exerts a significant influence on urban morphology, increases commercial development, and stimulates regional tourism, particularly within the hospitality and retail sectors. Empirical research shows that municipalities served by HST experience tourist growth rates exceeding four times the areas lacking access [27]. However, these benefits are not uniformly distributed. Smaller and medium-sized cities located in central and western regions frequently realize greater gains compared to saturated urban centers, while smaller or less-developed cities may experience limited or even negative effects due to a siphon effect, necessitating context-specific planning initiatives [28].

The spillover effects of HST extend beyond directly connected nodes. Furthermore, peripheral areas indirectly connected to HST lines experience tourism-related growth, affirming the broader spatial implications of HST systems [24]. In this context, system dynamics modeling is essential to capture the complex interconnections among transportation, land use, and economic activity [29].

Despite the increasing number of passengers, assessing the operations of the Jakarta-Bandung HST over the next decade will be crucial to increase ridership. Central and regional governments need to implement strategic policies that promote mass transit use, such as enhancing connectivity, improving tourism attractions, and developing areas around stations to stimulate investment interest. The potential for HST Jakarta-Bandung to reach a target of 30,000 passengers per day during certain months, particularly around holidays and national celebrations, is promising. The capacity of HST and the available land are sufficient to accommodate passenger growth in the coming decade. However, changes in land use resulting from increased economic activity due to HST Jakarta-Bandung expansion have not yet been included in the analysis.

7. CONCLUSION

In conclusion, the development and operation of HST infrastructure connecting Jakarta and Bandung offered additional transportation options for travelers heading to Bandung and contributed to sustainable regional growth. Moreover, the projected increase in passenger volumes influenced the growth of the hospitality industry and the allocation of land resources within Bandung, enhancing the appeal as a tourist destination.

Empirical evidence showed that HST users reported low sensitivity to fare structures, as shown by minimal behavioral changes in response to fare increases on weekends. A series of simulations aimed at enhancing passenger numbers comprised improving accessibility to and from train stations, coordinating tourism promotional events, and implementing policies to reduce fuel subsidies.

Government intervention was reported to be essential in promoting the growth of HST patronage between Jakarta and Bandung. HST systems played a critical role in improving regional economic development by increasing passenger numbers and prompting changes in land use patterns. Key factors in choosing a transportation mode such as HST included cost-effectiveness and operational efficiency. Even though an increase was anticipated over the next 10 years, achieving the daily target of 30,000 to 60,000 passengers remained challenging, except during peak periods such as December, influenced by holiday seasons and major events. The capacity of the Jakarta-Bandung HST and available land were still adequate to accommodate expected passenger growth. The effects of increased economic activity on land use due to the expansion of Jakarta-Bandung HST were not fully accounted for regarding land availability. Therefore, government intervention was important for enhancing passenger capacity. A promising strategy for future research was the implementation of a Transit-Oriented Development (TOD) policy around the Jakarta-Bandung HST stations. This policy had the potential to provide several benefits, including improved accessibility and connectivity, increased Jakarta-Bandung HST passenger volumes, stimulation of economic growth and investment, optimized land use, and reduced reliance on private vehicles. Further research should prioritize TOD as a key strategy for the long-term development of Jakarta-Bandung HST.

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