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Analysis of Factors Causing Commuter Train Delays in the Greater Jakarta Area

Prasadja Ricardianto[1*], Eko Purnomo[2], Erna Widodo[3], Masjraul Hidayat[4]

[1,2,3,4]*Trisakti Institute of Transportation and Logistics, Jakarta, Indonesia*

***Corresponding author:** ricardianto@gmail.com |

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Abstract

Purpose: This study aims to analyze the factors causing commuter train delays in the Greater Jakarta Area.
Research Methodology: This study uses the Analytic Hierarchy Process to analyze timeliness. The number of informants was 12, consisting of five people from regulators, five people from operators, one expert in the field of railways, and users of commuter trains in Jakarta, Bogor, Depok, Tangerang, and Bekasi.
Results: The results show that commuter train delays in the Greater Jakarta Area were mainly caused by operational conflicts with long-distance and freight trains, the Manggarai Station construction under the Double Double Track project, signaling system changes, and speed restrictions at Manggarai Station.
Conclusions: The study concludes that commuter train delays in the Greater Jakarta area are primarily caused by speed restrictions at Manggarai Station due to Double-Double Track construction, signal disturbances, operational follow-ups with long-distance and freight trains, and accidents at level crossings.
Limitations: The study is limited by a small number of informants (12) and focuses on one commuter line segment, which may restrict generalizability to other lines or regions.
Contributions: The study provides practical insights for railway operators and policymakers to improve train timeliness, optimize operational patterns, and prioritize infrastructure upgrades, contributing to commuter rail service quality research.

Keywords: *Commuter Train, Double Track, Timeliness, Train Delays*

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1. Introduction

The hope of solving urban transportation problems in the future is the development of rail-based mass transportation, especially in metropolitan areas. Trains, with their advantages as a cheap, safe, and land-saving means of land transportation, and their ability to transport passengers and goods in large quantities, can compete with other modes of transportation. In particular, in the Jakarta Bogor, Depok, Tangerang, Bekasi area, rail transportation operated by the Commuter Line Operator is expected to continue to improve the quality of its service so that customer loyalty can increase and customers continue to use the Jakarta, Bogor, Depok, Tangerang, and Bekasi commuter train services. Jakarta, Bogor, Depok, Tangerang, and Bekasi Commuter Line operators are expected to retain and attract new users (Bakti et al.,

2020; Setyawati, 2022).

Commuter trains are categorized as urban trains, where according to Law number 23 of 2007 concerning Railways, urban railways are railways that serve the movement of people in urban areas and/or round-trip journeys with coverage of the entire city administration area and/or exceeding the city administration area (UU RI, 2007). The urban railway service network located in an urban area may extend beyond one province, exceed one district/city in one province, and be within one district. With the various advantages of the train mode, such as transport capacity, energy efficiency, environmental friendliness, regularity, and direct access to the city center, the strategy for developing the urban rail network is fully focused on commuter transport services. The policies that will be taken to achieve the target of developing the railway network and services include (1) improving the quality of service, security, and safety of railways; (2) increasing the role of urban and intercity trains; (3) integrating rail services with other modes by building access to airports, ports, and industrial areas; (3) increasing the affordability (accessibility) of the community to rail services through the Public Services Obligation mechanism; (4) improving the regional economy by increasing community accessibility; and (5) improving urban and intercity connectivity.

The main problem in the Commuter Train service is the timeliness of travel, which often experiences technical and non-technical problems, such as train queues at the station, resulting in an average delay of more than 30 minutes. Several incidents of delays still occur with commuter train services, such as (1) accumulation of passengers at Jatinegara station, (2) drop in commuter train in Bogor, (3) transfer of double-double track, (4) delay of 30 minutes at Pasar Minggu, (5) impact of infrastructure maintenance at Manggarai station, and (5) fallen tree. The Ministry of Transportation and operators have made various efforts to improve the reliability of infrastructure and human resources but have not been able to improve the timeliness of travel. This shows that there are problems that have not been resolved. The percentage of on-time departures for the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train is still better when compared to the percentage of arrivals, with a fluctuating trend between January and July 2019. To date, there have been no studies or data on the number of losses experienced by Jakarta Bogor, Depok, Tangerang, and Bekasi Commuter Train operators and passengers. However, the costs that must be incurred due to untimely travel times are very large because they cannot be calculated in real terms, such as the loss of costs incurred by passengers who are late for work or other activities, recovery costs, social impacts, and additional operational costs that must be borne by the operator.

Overall, research Kuncoro and Harahap (2021) and Widiarto (2018) on commuter traffic in Jakarta, Bogor, Depok, Tangerang, and Bekasi, especially the Jakarta-Bekasi route, states that the operational performance of rail transportation from the On Time Performance aspect still exceeds the delay tolerance. There were two dominant factors causing the deviation of the Jakarta Bogor, Depok, Tangerang, Bekasi commuter train travel time, namely the weakness of train travel planning and the limited and lack of reliability of the railway infrastructure in Jakarta Bogor, Depok, Tangerang, Bekasi, which has not been able to support a smooth operation pattern. The commuter line train departing from Bogor station was not on time because the distribution of scheduling was outside the upper limit of 52.08 and the lower limit of 22.43.

The results of the study Yusrani et al. (2021) showed that the satisfaction index value of service users at the Manggarai Station, Jakarta was good at 78.59 percent. Another study by Heriyanto (2021) and Tambunan (2020) in Greater Jakarta on the Parungpanjang-Tanah Abang cross shows that service reliability is based on on-time performance during peak hours, which is still below the tolerance limit or relatively good performance. Other research outside Jabodetabek by Dwiatmoko et al. (2020) and Keke et al. (2021) at Surabaya Gubeng Station and Sidoarjo Station, which is used to serve the Kertasusila Commuter Transport Gate, especially for the Sidoarjo-Surabaya Gubeng crossing, East Java,

has completed commuter passenger service facilities, while services that must be maintained are the availability of operating schedules and network maps.

2. Literature Review

2.1 Timeliness

The timeliness and reliability of public transportation, especially trains, are important components of service quality for achieving passenger satisfaction. The timeliness factor is easy to measure and manage, and from the passenger's perspective, it is an important indicator of railway service (Agusinta et al., 2021; Lesmini et al., 2022). Therefore, timeliness is the execution of an agreement at a certain time between parties. In the railway sector, this agreement is realized by means of a travel schedule that explains where and at what time certain trains are in the form of a Train Trip Chart. Timeliness of commuter electric train services according to Saputra et al. (2022) and Tambunan (2020) is now one of the most important factors. Puri et al. (2020) concluded that current commuter services have considered the economic efficiency of commuter services.

Timeliness is influenced by several stakeholders and factors. Prospective passengers must be at the station on time when the train leaves. The train facilities must function properly, and the driver must arrive on time. Several train operators in several countries have set different tolerance limits for punctuality. Timeliness improvements can be made if there is a synergy between regulators and operators with a good planning system, setting high operational standards, increasing the frequency of train trips that are adjusted to traffic capacity, and increasing the average speed in accordance with the technical capabilities of infrastructure and facilities (Achir et al., 2022; Jiang et al., 2022). Dwiatmoko et al. (2020) and Fadhilah et al. (2022) argued that confirmation of actual train arrivals at each station via local cross circuits and motion detectors is the key to accurate arrival and departure status information.

The timeliness database is closely related to performance and the proper process of maintaining railway facilities and infrastructure. These data are often used as performance measures and become an important information base for further improvement. The causal factors that affect timeliness according to Ardhianti et al. (2022) and Dong et al. (2020) are the availability and reliability of railway infrastructure, schedule planning, rolling stock conditions, weather, and personnel. In addition, he explains that information and requirements related to the punctuality of train travel include causal factors to support systematic improvements. Availability performance is the ability of a part to perform the required function under certain conditions and at a certain time or during a certain time interval, assuming that all the necessary resources are available (Palmqvist et al., 2017).

In several countries, Dong et al. (2020) and Hasan (2022b) explained that integrated optimization in China starts from planning train stops and scheduling times for commuter trains. In Malaysia, perceptions and expectations are contradictory, especially regarding non-compliance with schedules and announced travel times and headways. In addition, research Ibrahim et al. (2019) and Setyawati (2022) in Malaysia shows that the timeliness of train departures and arrivals is important, but must be considered by management to increase passenger satisfaction and improve commuter train passenger services. While commuter trains in Europe, Arimbawa and Suryawan (2022) and Bakti et al. (2020) explains that the costs due to travel time delays reach €150 million annually and can be eliminated if there is an increase in punctuality performance by 90%.

2.2 Train Delays

Most train delays are caused by the spread of delays in train operations, both in time and distance. This is the nature of railway operations, which are interdependent on train services, meaning that when certain trains are late, it results in all other train travel times being delayed (Hasan, 2022a; Hendiyana

et al., 2022). These delays are secondary delays (König, 2020; Shakibayifar et al., 2020). Based on Lesmini and Fadhlurrahman (2023) and Palmqvist et al. (2017), secondary delay deviation is defined as a deviation from the planned schedule caused by crossing trains or waiting for certain delayed trains. Denti and Burroni (2023), Monsuur et al. (2021), and Widiyanto et al. (2023) explains that secondary delays include (1) train operations, if the journey of one train has been delayed from the beginning and it is impossible to recover from the delay, then the train will experience delays until the final destination station, and (2) infrastructure use, which can be determined as traffic capacity. The traffic capacity is not affected by the headway but is influenced by the condition of infrastructure, operating facilities, and facilities. The headway is adjusted according to the traffic capacity. For example, if the traffic capacity is 120 trains/day, then the headway is only 120/24 trains/h, which is 5 trains/h.

The results of previous research by Murali et al. (2010) stated that the cause of the delay was infrastructure. The results of his research also explain that infrastructure and information can support stakeholders in making decisions to improve the timeliness of train trips more efficiently and effectively. In addition, Palmqvist et al. (2017) explained that the causes of train delays are weather, train trip chart planning, and infrastructure. Other causes of delays according to Hidayat et al. (2018) are due to the work of train derailments, window time for infrastructure maintenance, acceleration of railway rehabilitation and maintenance work, as well as locomotive crises caused by the large number of train trips. These delays are secondary. Secondary delays are a major problem in railway networks with high crossovers and limited traffic capacity. This problem is experienced in the commuter rail network, where there are many crossings with long-distance trains, especially on the Bogor cross and middle routes. Crossings also occur at the Jatinegara, Manggarai, and Gambir stations, causing the Jakarta Bogor, Depok, Tangerang, and Bekasi Commuter trains to be hampered because they have to wait for other trains to enter. This can be overcome by improving infrastructure, planning travel schedules, and proper operating patterns by considering traffic capacity, stations, and the number of facilities (Mikulčić & Mlinarić, 2021).

2.3 Commuter Line

Commuter or shuttle trains are urban trains that serve the movement of people in urban areas and/or round trips with coverage throughout the city administration area and/or beyond the city administration area (UU RI, 2007). Urban rail network development strategies are fully focused on serving commuter transport. In Indonesia, the need for urban trains must be available in big cities with a population of more than one million people, and internally, the city's movement already requires mass transportation in the form of urban trains (Hernawan et al., 2023). This urban train serves commuter trips for the city's residents and local trips, and its services are integrated with other land transportation modes. Based on Yusrani et al. (2021), the advantages of the current train are commuter trains as the transportation of choice when compared to other land transportation modes, but in reality, it has not been supported by adequate services (Parmenas et al., 2023). The Jabodetabek commuter train is an electric train that connects big cities with small cities in the vicinity or two cities close to each other. Currently, in Jakarta and the surrounding areas, the main task of PT. KAI Commuter Indonesia as the operator of commuter rail transportation services using Electric Rail Train facilities in the Jakarta, Bogor, Depok, Tangerang (Serpong) and Bogor (Jabodetabek) areas as well as business in the non-passenger transportation business sector. It was found that some of the main problems in commuter trains were schedule adjustments and train rescheduling, which have been studied (Fourie & Zhuwaki, 2017).

2.4 Double Double Track

The dual-track configuration can contribute to reducing commuter rail delays by providing maximum passenger train speeds (Connolly & Woodward, 2020; Li et al., 2025). Murali et al. (2010) explained that scheduling trains on double tracks requires simulation-based modeling that can generate estimates of delays in track segments as a function of traffic conditions and network topology. The addition of

double-track trains does cause an increase in the volume of trains and noise in the surrounding settlements. However, testing the noise level by Anagnostopoulos (2025) and Susanto et al. (2023) on the double track shows that the noise intensity on the right and left sides of the double-track rail is still above the standard noise threshold value. The results of research in West Java with the design of the double-track operation pattern of the Gedebage-Cicalengka Railway indicate that the existence of a double-track development plan will increase the traffic capacity by 200% (Wang et al., 2024).

3. Methodology

This study used a qualitative method to describe the factors that cause delays in the Jakarta Bogor, Depok, Tangerang, Bekasi commuter train to improve travel timeliness. Data collection was carried out under natural conditions, primary data sources, direct observation, in-depth interviews, Focus Group Discussions, and triangulation. The processing was performed using Expert Choice. The Analytic Hierarchy Process (AHP) was used to analyze timeliness. The use of AHP, a multi-criteria decision-making method, can solve complex and unstructured problems into groups arranged into a hierarchy (Saaty, 2012). The working principle of AHP is the simplification of an unstructured, strategic, and dynamic complex problem into parts and arranged hierarchically. The number of informants taken was 12, consisting of five people from regulators, five people from operators, one expert in the field of railways, and users of commuter trains Jakarta Bogor, Depok, Tangerang, and Bekasi. The results of horizontal data processing show the level of influence between one factor and another at one level of the hierarchy so that the dominant factor affecting the delay of the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train crossing Bogor-Manggarai in 2019 can be identified. The AHP has been used in other studies to determine the ranking of each factor and mode of transportation (Mayo & Taboada, 2020). Overall destination was the most preferred mode of transportation for each demographic group. Research in the field of commuter trains has also been conducted (Kamiński, 2020; Nugeraha & Kurniawati, 2020).

4. Results and Discussion

4.1 Results

4.1.1 Cause of Delay

The informants interviewed were from the regulator who worked in the rail transportation sector (five people), operators in the railway sector (five people), experts in the railway sector (one person), and Jabodetabek commuter rail service users (one person). The Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train crossing Bogor-Manggarai during January-June experienced a percentage of on-time departure of 65% and arrival time of 52%. This is still far from the expectations of users who want more punctuality. The average departure delay is four minutes and the average arrival delay is seven minutes, but if you look at the magnitude of the delay at peak hours in the morning and evening, the delay will feel like an example in January 2019, when the Jakarta-Bogor route experienced a delay in departure of 75 minutes and 77 minutes late arrival.

Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train Delays Crossing Bogor-Manggarai. Follow-ups and traffic changes with intercity and freight trains occurred at stations such as Gambir, Jakarta Kota, Pasar Monday, Jatinegara, Manggarai, Cakung, and Bekasi. The operation pattern of the Jabodetabek Commuter Train is still mixed with long-distance and freight trains. If long-distance and freight trains experience delays in entering Manggarai station, then for operational reasons, long-distance and freight trains are prioritized to enter Manggarai station and Gambir station. This causes a domino effect on other trains. With the long-distance train fully operating at Gambir station while the traffic at Jatinegara and Manggarai stations is reduced, follow-ups will still occur. Not infrequently, one commuter train is followed by two long-distance trains that arrive late at Manggarai.

The planning schedule and maximum speed must be prepared based on the availability and reliability of the existing railway infrastructure, including infrastructure, facilities, and human resources. With the limitations of the existing infrastructure, supporting data and updated information are needed so that scheduling optimization efforts can be carried out, accompanied by a strict Jakarta Bogor, Depok, Tangerang, Bekasi commuter rail system of supervision and control.

4.1.2 Speed Limitation at Manggarai Station

The construction of the Manggarai station as part of the double-double track project aimed to improve services for rail service users. However, in the implementation process, it resulted in delays for the Jakarta, Bogor, Depok, Tangerang, and Bekasi Commuter Train operations due to changes in operating patterns. Besides that, the signaling system at the Manggarai station also underwent a change from the Westinghouse Solid State Interlocking system to the Kyosan K5B system. This requires adaptation time for Manggarai to manage the operation of trains leaving and entering the station. In addition, the characteristics of the signal systems are also different; the SSI system allows trains to go hand in hand when entering or leaving the station, but the Kyosan K5B system does not allow this. Speed limits are also imposed because of changes in the position of the money order, advance signal, and tracks. When the train is about to enter Manggarai station from the direction of Cikini station, if previously it could go straight to traffic 5 and 6, with some changes required to enter traffic 8 which turns, then speed restrictions cannot be avoided.

4.1.3 Signal Interference and Upstream Electricity Occurs

Signaling is one of the causes of these delays. Based on data from the management of the Indonesian Railway Operation Area I Jakarta, five signal systems are present in Jakarta, Bogor, Depok, Tangerang, Bekasi, and Cikarang. They are the Kyosan K5B system for the Manggarai-Cikarang route, Westinghouse Solid State Interlocking system for the Jakarta Kota-Bogor route, SSI GEC Alstom for the Pondok Ranji-Serpong route, and Len 02 LRS interlocking system for the Grogol-Serpong route. The Westinghouse Solid State Interlocking (SSI) system for the Jakarta Kota-Bogor Crossing has been operating since 1994, requires more intense maintenance, and is currently being renewed.

4.1.4 An Accident Happened at the Crossing

The KRL operating system demands accuracy of travel time and a high level of security and safety, in addition to infrastructure. The existence of accident-prone level crossings also affects punctuality (Meutia & Yuliana, 2019). In accordance with Law 23 of 2007, Article 91 states that the intersection between rail and road traffic is not made on a level, and exceptions can only be made while ensuring the safety and smoothness of rail and road traffic (UU RI, 2007).

Analytical Hierarchy Process (AHP) Analysis Horizontal processing using the AHP method shows related elements at one hierarchical level. In this case, it is a factor that caused delays in the Jakarta Bogor, Depok, Tangerang, Bekasi commuter train crossing Bogor-Manggarai in 2019. The steps for using AHP in the analysis process are as follows: (1) Determine the focus of research, which is the core of the problem; (2) After identifying the causes of delays in the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train on the Bogor-Manggarai crossing, which are four causes, the informants are asked which factors are considered the most dominant as the cause of train delays. Jakarta Bogor, Depok, Tangerang, Bekasi commuters across Bogor-Manggarai, (3) The next step is to be included in the expert choice 11 applications with an inconsistency value of not more than 10% (Table 1).

4.1.5 Level 1, Focus

The focus of this problem is the factors that cause delays in the Jakarta-Bogor, Depok, Tangerang, and Bekasi commuter trains to improve travel time (Bogor-Manggarai Cross).

Table 1. Factors Causing Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train Delays

Dominant Factor	Result	Priority
The occurrence of follow-ups and traffic changes with inter-city trains and freight trains	0.249	2
There are speed restrictions at Manggarai Station as a result of the construction of the Double Double Track Project	0.560	1
There has been a signal disturbance and overflow electricity	0.095	3
There was an accident at the crossing	0.095	4

Based on Table 1, the final result of vertical processing was the selection of the cause of delays in the Jakarta Bogor, Depok, Tangerang, Bekasi commuter train to improve travel timeliness. It can be seen that the dominant factor affecting the achievement of focus is the speed limitation at Manggarai Station as a result of the construction of the Double-Double-Track (DDT) Project with a weight of 0.560.

4.2 Discussion

From interviews with informants consisting of regulators, operators, train users, and experts in the railway sector, it was found that several factors were the cause of delays in the journey of the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train crossing Bogor-Manggarai, especially between January and July 2019, experienced by users, especially in the morning and evening during peak hours. The reason is that the railway infrastructure is inadequate and is currently still in the process of upgrading and developing double-double-track infrastructure at Manggarai Station–Bekasi Station, which is carried out by the Directorate General of Railways. This problem has been recognized for a long time, and there has been an agreement with the Japanese side to resolve it with the Loan IP-508 Railway Electrification and Double-Double Tracking of the Java Main Line Project (I), which was signed in 2001. Since the agreement was signed, several extensions have been made until 2019 and the change in the scope of the electrification of Bekasi–Cikarang. In 2014, the Double-Double Track development activity underwent a funding change, which was funded through the State Sharia Securities (SBSN) issuance scheme, and the construction was divided into two stages (the first stage was carried out in 2014–2020 and the second stage in 2019–2020).

This development process resulted in speed restrictions when entering Manggarai Station, especially when traffic changed. This is coupled with changes in the signaling system at Manggarai Station from the original European SSI system to the Japanese Kyosan system, changes in signaling location, changes in the location or shift of drafts, and changes in tracks at Manggarai Station.

The process of following up the Jabodetabek Commuter Train with long-distance and freight trains at several stations, such as Gambir, Jakarta Kota, Pasar Minggu, Jatinegara, Manggarai, Cakung, and Bekasi stations, was one of the causes of delays due to operational reasons that prioritize long-distance and freight trains. Currently, the Directorate General of Railways is constructing a double-track crossing south of Java, which is one of the causes of delays in long-distance and freight trains when they enter Jakarta. This causes a domino effect on Jakarta Bogor, Depok, Tangerang, and Bekasi commuter trains.

Signals that are more than 30 years old and the existence of level crossings are included as causes of delays for the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train. This is being handled by the Directorate General of Railways.

4.2.1 Focus Group Discussion (FGD)

Focus group discussions (FGD) were conducted to validate the results of interviews with related parties to provide recommendations to improve the timeliness of Jakarta Bogor, Depok, Tangerang, Bekasi

Commuter Train trips. The FGD was carried out in two stages, the first being the FGD with the regulator group, with five participants consisting of informants representing the fields of traffic, planning, infrastructure, and safety. The second FGD was conducted with the operator group, with four participants consisting of informants/experts representing the operational field. From the results of the FGD in the two groups, information was obtained on the causes of delays in the Jakarta-Bogor-Depok-Tangerang-Bekasi commuter train and several inputs/recommendations to increase the travel time of the Jakarta-Bogor-Depok-Tangerang-Bekasi commuter train across Bogor-Manggarai. From the results of interviews and FGDs, it was concluded that the causes of delays were: (1) the occurrence of follow-ups and traffic changes with intercity and freight trains at stations such as Gambir, Jakarta Kota, Pasar Minggu, Jatinegara, Manggarai, Cakung, and Bekasi; (2) speed restrictions at Manggarai Station as a result of the construction of the Double-Double Track project; (3) signal disturbance and Overflow Electricity; and (4) accidents at the crossing.

This study is in line with the findings of previous research conducted by Nisrin and Djamhur (2019) at Manggarai Station, Jakarta, which found that the performance variable that must be maintained is the accuracy of the train schedule. In addition, the results of the study by Bakti et al. (2020) and Puri et al. (2020) show that the satisfaction index value of Manggarai Station service users is 78.5%, and the level of service has not met the expectations of commuter train passengers. At the Bekasi-Manggarai KRL Commuter Line station, the suitability of train arrivals and departures needs to be improved, and service quality must be improved by increasing the accuracy of commuter schedules (Dong et al., 2020). Meanwhile, according to the Bogor-Manggarai crossing, Erlangga et al. (2020) stated that many passengers have not been transported during peak hours, and there is a density of passengers in the KRL series. Based on studies related to the punctuality of commuter trains, this study is in line with and supports the findings of previous studies.

5. Conclusions

There have been follow-ups and traffic changes with intercity and freight trains at stations such as Gambir, Jakarta Kota, Pasar Monday, Jatinegara, Manggarai, Cakung, and Bekasi, and the operation pattern. of the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train is still mixed with long-distance and freight trains. The construction of the Manggarai station as part of the Double Double Track project aimed to improve services to rail service users, but in the implementation process, it resulted in delays for the Jakarta Bogor, Depok, Tangerang, and Bekasi Komuter Train operating due to changes in operating patterns. In addition, the signaling system at the Manggarai station also underwent a change from the Westinghouse Solid State Interlocking system to the Kyosan K5B system. Based on the AHP analysis, the most dominant factor causing delays in the Jakarta Bogor, Depok, Tangerang, Bekasi commuter train crossing Bogor-Manggarai is the speed limit at Manggarai Station US due to the construction of the Double Double Track project, with a weight of 0.560.

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Author Contributions

PR contributed to conceptualization, methodology, and writing of the original draft. EP was responsible for data collection, formal analysis, supervision, and review. EW handled literature review, validation, and project administration. MH provided expert consultation, data interpretation, and review of technical

aspects.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this study. This research was conducted independently, and no financial or personal relationships influenced the results or interpretation of the findings.

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