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ANALYSIS OF FACTORS CAUSING JABODETABEK COMMUTER TRAIN DELAY

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ABSTRACT

The goal to be achieved through this research is to identify the factors that cause delays in the commuter train journey across Bogor-Manggarai Jakarta. The research question is why there is a delay in the journey of the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train crossing Bogor-Manggarai. This study uses the Analytic Hierarchy Process to analyze timeliness. With the number of informants taken as many as 12 informants consisting of five people from regulators, five people from operators, one expert in the field of railways and users of commuter train of Jakarta Bogor, Depok, Tangerang, Bekasi. From the measurement results, it was found that the Jakarta, Bogor, Depok, Tangerang, Bekasi Commuter train was still experiencing delays, due to follow-ups and cross-changes in the operation pattern of the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train which was still mixed with long-distance and freight trains, the construction of the Manggarai station as part of the Double Double Track project, the signaling system at the station. Manggarai also underwent changes and there were speed restrictions at Manggarai Station. Recommendations are to complete the construction of the Manggarai and Jatinegara stations which are useful for separating inter-city and urban rail travel, updating the signaling system on the crossing between Bogor Station-Manggarai Station and City Station which is now 30 years old, handling and improving level crossings with coordinate with related units.

Keyword: commuter train; double double track; timeliness; train delays

1. INTRODUCTION

The hope of solving urban transportation problems in the future is the development of rail-based mass transportation, especially in metropolitan cities. The train with its advantages as a means of land transportation that is cheap, safe, saves land and is able to transport passengers and goods in large quantities, makes it able to compete with other modes of transportation. Especially in the Jakarta Bogor, Depok, Tangerang, Bekasi area, rail transportation which is carried out 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, Bekasi commuter train services. Jakarta, Bogor, Depok, Tangerang, Bekasi Commuter Line operators are expected to retain existing users and attract new users (Bakti et al., 2020).

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 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, 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 that 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 able to be resolved. The percentage of on time departure 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-July 2019. Until now there has been no study or data on the number of losses experienced by Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train operators and passengers, but the cost The costs that must be incurred due to untimely travel times are very large because they cannot be calculated in real terms, such as 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 (Widiarto, 2018)) on commuter traffic in Jakarta Bogor, Depok, Tangerang, 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. In a previous study, (Sugiarto et al., 2012) explained, 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 so that it has not been able to support the smooth operation pattern. (Putri et al., 2020), in their study stated that the schedule for 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 Manggarai Station, Jakarta was good at 78.59 percent. Another study by (Tambunan, 2020) in Greater Jakarta on the Parungpanjang-Tanah Abang cross shows that service reliability based on on time performance during peak hours is still below the tolerance limit or relatively good. The research findings by (Lestari, 2014) the Jakarta-Bekasi commuter train, explained that the number of train facilities still needed 16 trips/series per day, resulting in delays in service. Other research outside Jabodetabek by (Dwiatmoko et al., 2020) 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 that is, the availability of operating schedules and network maps.

2. LITERATURE REVIEW

Timeliness

Timeliness and reliability of public transportation, especially trains, are important components in service quality to achieve passenger satisfaction (Goverde, 2005). Timeliness factor is easy to measure and easy to manage and from the passenger's perspective is an important indicator of railway service. Therefore, timeliness is the execution of an agreement at a certain time between different parties (Granström, 2008). 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 (Farajpour et al., 2007) is now one of the most important factors. (Yulia et al., 2014) concluded that current commuter services have considered the economic efficiency of commuter services.

Timeliness is influenced by several stakeholders and other factors (Nyström & Soderholm, 2005). Prospective passengers must be at the station on time when the train departs. The train facilities must function properly and the driver arrives on time. Several train operators in several countries set different tolerance limits on 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 (Goverde, 2005). It is argued (Kemp & James, 2003) that confirmation of actual train arrivals at each station, via local cross circuits, motion detectors, is the key to accurate arrival and departure status information.

Timeliness database is closely related to performance performance and how the process of maintaining railway facilities and infrastructure is carried out properly. This data is often used as a performance measure and becomes an important information base for further improvement (Nyström, 2008). The causal factors that affect timeliness according to (Nyström, 2008), are the availability and reliability of railway infrastructure, schedule planning, rolling stock conditions, weather and personnel. In adtiton, he also explains that information and requirements related to the punctuality of train travel include the causal factors in order 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 all the necessary resources are available (Granström, 2008).

In several countries, (Dong et al., 2020) 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 non-compliance with schedules and announced travel times, headways (Bachok et al., 2013; Khalid et al., 2014). In addition, research (Ibrahim et al., 2019) in Malaysia that the timeliness of train departures and arrivals, is considered important, but must be considered by management to increase passenger satisfaction and improve commuter train passenger services. While commuter trains in Europe, (Nyström, 2008) explain 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%.

Train Delays

Most of the causes of train delays are due to the spread of delays in train operations, both in time and distance (Vromans, 2005). This is the nature of railway operations which are interdependent between train services, meaning that when certain trains are late, it will result in all other train travel times being delayed. These delays are secondary delays. Based on (Goverde, 2005), defines secondary delay as deviation from the planned schedule caused by crossing trains or waiting for certain trains that are delayed. (Vromans, 2005) explains that what is included in the secondary delays are; (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, (2) Infrastructure Use, can be defined 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 adjusts to the traffic capacity. for example, if the traffic capacity is 120 train/day, then the headway is only 120/24 train/hour is 5 train/hour.

The results of previous research by (Granström, 2008), which stated that the cause of the delay was infrastructure. The results of his research also explain that the cause of delays is that infrastructure and information can support stakeholders in making decisions to improve the timeliness of train trips in a more

efficient and effective way. In addition, (Palmqvist et al., 2017) explains 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 and acceleration of railway rehabilitation and maintenance work, as well as locomotive crises caused by the large number of train trips. These delays are secondary delays. Secondary delays are a major problem in the railway network which has high crossovers with 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 the middle route. Crossings also occur at the Jatinegara, Manggarai and Gambir stations, causing the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter train to be hampered because they have to wait for other trains to enter. This can be overcome, among others, by improving infrastructure, planning travel schedules and proper operating patterns by considering traffic capacity, stations and number of facilities.

Commuter Line

Commuter or shuttle trains are urban trains, which 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 strategy is fully focused on serving commuter transport. In general in Indonesia, the need for urban trains must be available in big cities that have a population of more than one million people and internally the city's movement already requires mass transportation in the form of urban trains. This urban train serves commuter trips for the city's residents and local trips whose 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. The Jabodetabek commuter train is an electric train that connecting big cities with cities small in the vicinity or two cities close together (Lestari, 2014). Currently in Jakarta and 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 been studied (Burdett & Kozan, 2014; Fourie & Zhuwaki, 2017; Jespersen-Groth et al., 2009).

Double Double Track

The dual track configuration can contribute to reducing commuter rail delays or delays by providing maximum passenger train speeds (Sogin et al., 2013). (Murali et al., 2010) explained that scheduling of trains on double double tracks requires simulation-based modeling that can generate estimates of delays in track segments as a function of traffic conditions, as well as 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 (Ahmad & Margiantono, 2021) testing the noise on the double track 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% (Siregar et al., 2020).

3. METHODS

This study uses 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 in natural conditions, primary data sources, direct observation, in-depth interviews, Focus Group Discussions, and triangulation. Processing is done using Expert Choice. Research analysis uses the Analytic Hierarchy Process (AHP) to analyze timeliness. The use of AHP, as 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 in a hierarchy. With the number of informants taken as many as 12 informants consisting of five people from regulators, five people from operators, one expert in the field of railways and users of commuter train Jakarta Bogor, Depok,

Tangerang, Bekasi. The results of horizontal data processing show the level of influence between one factor and another in one level of the hierarchy so that the dominant factor that affects the delay of the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train crossing Bogor-Manggarai in 2019. The use of AHP is used in other studies to determine the ranking of each factor and mode of transportation (Mayo & Taboada, 2020). The overall destination is the most preferred mode of transportation for each demographic group. Research in the field of commuter trains has also been carried out by (Kamiński, 2020; Nugeraha & Kurniawati, 2020).

4. FINDINGS AND DISCUSSION

Cause of Delay

The informants interviewed were from the regulator who worked in the rail transportation sector as many as five people, operators in the railway sector as many as five people, experts in the railway sector as many as one person and Jabodetabek commuter rail service users as many as 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 to increase. 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 the Jakarta-Bogor route experienced a delay in departure 75 minutes and 77 minutes late arrival.

Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train Delays Crossing Bogor-Manggarai. The occurrence of follow-ups and traffic changes with inter-city trains and freight trains 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 trains and freight trains. If long-distance trains and freight trains experience delays in entering Manggarai station, then for operational reasons, long-distance trains and freight trains are prioritized to enter Manggarai station and Gambir station. This causes a domino effect for other trains. With the long-distance train fully operating at Gambir station while the numbers of 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 to 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.

Speed Limitation at Manggarai Station

The construction of the Manggarai station as part of the Double-double track project with the aim of improving services to rail service users, but in the implementation process resulted in delays for the Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train operating 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 in managing the operation of trains leaving and entering the station. Besides that, the characteristics between 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 due to changes in the position of the money order, advance signal and track. 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.

Signal Interference and Upstream Electricity Occurs

Signaling is one of the causes of delays. Based on data from the management of the Indonesian Railways Operation Area I Jakarta, there are five signal systems in the areas of Jakarta, Bogor, Depok, Tangerang, Bekasi, and Cikarang. They are the Kyosan K5B system for the Manggarai-Cikarang route, the Westinghouse Solid State Interlocking system for the Jakarta Kota-Bogor route, the SSI GEC Alstom for the Pondok Ranji-Serpong route, and the 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 in the process of being renewed.

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 support, the existence of accident-prone level crossings also affects punctuality performance (Aswad, 2013). In accordance with Law 23 of 2007, article 91 states that the intersection between rail and road traffic is not made on a level, 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 in one hierarchical level. In this case, it is a factor that causes delays in the Jakarta Bogor, Depok, Tangerang, Bekasi commuter train crossing Bogor-Manggarai in 2019. The steps for using AHP in the analysis process; (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, then 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 application with an inconsistency value of not more than 10% (Table 1).

Level 1, Focus

The focus at the core of this problem is the factors that cause delays in the Jakarta Bogor, Depok, Tangerang, Bekasi commuter train to improve travel timeliness (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

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

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-July 2019 experienced by users, especially in the morning and evening, during peak hours. The reason is that the railway infrastructure is inadequate which 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 Java Main Line Project (I) which was signed in 2001. Since the agreement was signed, there have been several extensions. until 2019 and the change in scope to 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 changes in traffic. This is coupled with changes in the signaling system at the 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, changes in tracks at Manggarai Station.

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

Focus Group Discussion (FGD)

Focus group discussions (FGD) were carried out in order to validate the results of interviews with related parties in order to provide recommendations in order 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 carried out in 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 in order to increase the travel time of Jakarta Bogor, Depok, Tangerang, Bekasi Commuter Train across Bogor-Manggarai. From the results of interviews and FGDs that have been carried out, it was concluded that the causes of delays were: (1) The occurrence of follow-ups and traffic changes with inter-city trains and freight trains at stations such as Gambir, Jakarta Kota, Pasar Monday, Jatinegara, Manggarai, Cakung and Bekasi; (2) There are speed restrictions at Manggarai Station as a result of the construction of the Double-Double Track project; (3) There is a signal disturbance and Overflow Electricity; (4) There was an accident at the crossing.

This study is in line with the findings of previous research conducted by (Meutia & Yuliana, 2019; Nisrin & Djamhur, 2019) at Manggarai Station, Jakarta that the performance variable that must be maintained is the accuracy of the train schedule. In addition, the results of the study (Yusrani et al., 2021) show that the satisfaction index value of Manggarai Station service users is 78.5%, 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 must improve Service Quality by increasing the accuracy of commuter schedules (Nurnaningsih & Artiani, 2018; Puri et al., 2020). Meanwhile, according to the Bogor-Manggarai crossing (Erlangga et al., 2020), there are still many passengers who 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 researchers.

5. CONCLUSION AND RECOMMENDATION

There have been follow-ups and traffic changes with inter-city trains 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 trains and freight trains. The construction of the Manggarai station as part of the Double Double Track project with the aim of improving services to rail service users, but in the implementation process resulted in delays for the Jakarta Bogor, Depok, Tangerang, Bekasi Komuter Train operating 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. Based on the analysis using AHP, it was found that the most dominating factor as a cause of delay in the Jakarta Bogor, Depok, Tangerang, Bekasi commuter train crossing Bogor-Manggarai is that there is a speed limit at Manggarai Station as a result of the construction of the Double Double Track project with a weight of 0.560.

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