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MISSING LINK KOTA DEPOK
(Case Study: Management Missing Link at Kota Depok)

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ABSTRACT

In connection with the important role of the road network and connectivity of public transport in the area of the City of Depok, there is a problem called the missing link. The purpose of this study is reviewed from the aspects of road network performance, connectivity of activity centers, TOD areas and transportation nodes, then obtained by loading the Origin Destination Matrix (MAT) to the road network with the help of transportation modeling software using Saturn. Travel speed between cities / regencies in Jabodetabek or the origin destination of Depok City does not reach the target speed of 40 km / hour, and speeds between regions and within regencies/cities in Depok city. Tangerang Regency and Bekasi Regency have the lowest speeds, with the lowest values being 25.06 km/hour and 25.39 km/hour. So that the need to increase the capacity of the road network to and from Tangerang and Bekasi districts, for Depok city the average speed that occurs within the city is 28.81 km/hour, so it is necessary to increase the capacity of the road network. The TOD area will have a missing link if the TOD has no connectivity with the mass transit node at a distance of more than 800 meters and is not on the main high-capacity mass transit line, such as the Cinere TOD. The need for handling the missing link TOD area of the road network in the Greater Jakarta area, mainly Cinere - Fatmawati Station. And there is PKN that is not connected by public transportation to other PKN and is not connected with PKW in the same City, namely Cimanggis District, Depok City.

Key word: TOD; public transport; speed; MAT; transit.

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INTRODUCTION

The road network is a land transportation infrastructure that plays an important role in the transportation sector, especially for the sustainable distribution of goods and services. In urban and district planning and development, road facilities as one of the backbones of transportation are an integral part (Anonim, 2009).

With the changing times and the increasing use of land transportation, especially road transportation, the government is increasingly confused by the congestion that occurs. The road infrastructure network consists of nodes in the form of terminals, both passenger and freight terminals and traffic space. The traffic space in road transportation is in the form of roads which are hierarchically determined according to their roles, consisting of arterial roads, collectors and local roads. So far the government has planned various efforts to tackle traffic problems. Depok City is one of the cities that is included in West Java Province (West Java Governor Decree, 2011); (Law on Road, 2009); (Warpani S, 1990). This city is located in the south of DKI Jakarta Province. Depok City is a city administrative area originating from the pamekaran administrative area of Bogor Regency in 1982. Depok City is one of the suburbs of the DKI Jakarta Province, which is the city administrative area directly adjacent to the DKI Jakarta Province so that Depok City is directly affected by the multiplier effect of spatial planning and infrastructure development in DKI Jakarta Province.

Geographically, Depok City is located at the coordinates 6 ° 19'00 "- 6 ° 28" 00 "" LL and 106 ° 43 "00" - 106 ° 55 "30" East Longitude. Depok City has an area of 200.29 km2 and is directly adjacent to the North, South Tangerang City, Banten Province and DKI Jakarta Province. While the East is bordered by Bekasi City and Bogor Regency, the South West Province is bordered by Bogor Regency, West Java Province. Depok City has 11 Districts, namely Kec. Ciamanggis, Sukmajaya, Tapos, Sawangan, Pancoran Mas, Limo, Beji, Cinere, Bojongsari, Cipayung and Cilodong. Based

on (Central Bureau of Statistics, 2018) data, Depok City in 2018 figures in 2017, the population in Depok City was 2,254,513 people, with a male population of 1,135,539 people and 1,118,974 women with a sex ratio of 101.48 which means that there are 101 male population within 100 population within female. The population density in Depok City in 2017 has increased compared to 2016, which was 11,256 people/km^2, while in 2016 it had a population density of 10,883 people/km^2 (Depok City Regional and Development agency, 2011); (Depok City Regional and Development agency, 2015); (Minister of Transportation Regulation, 2015a); (Minister of Transportation Regulation, 2015b); (Minister of Transportation Regulation, 2015c).

Motor vehicle trips that apply in normal conditions are very much influenced by the condition of the vehicle and the condition of the rider (S.Syaiful, N.Wahid, 2020); (S.Syaiful, Y.Elvira, 2017).

Vehicles in good condition will make the driver comfortable, there will be no good noise generated by the engine or the vehicle supporting devices (Syaiful, Lutfi A, 2015); (Syaiful, 2015). So that you will get comfort in driving. The road that is traversed also affects the speed and speed of the vehicle, the better and smoother the road surface, the more comfortable the vehicle will be and vice versa, the easier it will be for the vehicle to maneuver, without causing the slightest noise (Thamrin, Syaiful, 2016); (S.Syaiful, A Fadly, 2020); (M Mubarak et.al, 2020); (Syaiful Syaiful, Sri Wiwoho Mudjanarko, 2019);

Planning steps:

1. Transportation System

   Transportation is the activity of moving people and goods from one place to another using a mode for these activitie.

2. Road Network Infrastructure

   Transportation infrastructure has two main roles, namely as a tool for directing development in urban areas and as an infrastructure for movement of people or goods due to activities in urban areas

3. Road Generation

   This stage aims to study and identify the magnitude of the generation and attraction of the movement by studying several variations of the relationship between movement characteristics and the land use environment.

4. Mode Selection

   This stage serves to calculate and estimate the number of flows of people or goods from the zone of origin to the zone of destination.

5. Route Selection

   Aim to allocate every movement between zones to the various routes most often used by someone moving from the origin zone to the destination zone (Tamin, 2000); (Tamin, 1997); (Tamin, 2008); (Setya Lessmana, 2013).

6. Road Section Capacity

   The road network capacity is the maximum traffic flow that a road network can maintain under certain conditions, which is expressed in units of passenger cars (SMP) per hour (MKJI, 1997); (Minister of Public Works Decree, 2009); (Meyrissa Putri Dewandari, 2018); (Minister of Transportation Regulation, 2015); (Government Regulation, 2014); (Government Regulation, 2006).

RESEARCH METHODS

During the first month of the study, the consultant had done several things as a first step for the overall study. Things that have been done include:

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1. Survey preparation in the form of selecting the survey method, preparing survey forms and equipment, determining the survey point and implementing Human Resources (HR).
2. Introduction of the study area in the form of development plans, institutional approaches, traffic systems, transportation facilities and infrastructure, land and environmental and socio-economic uses.
3. Updating the transportation model based on the primary survey results by calibrating the transportation model with a survey of passenger ups and downs and modal shift patterns.
4. Analysis of missing links in the three stages of missing links, namely the missing link for public transport, missing link in connecting TOD, and missing link connecting transportation nodes.
5. Primary survey of passenger ups and downs and interview survey for public transport users in Depok City.

RESULTS AND DISCUSSION

The missing link can be interpreted into 2 categories, namely the missing link on the road network and the missing link for the public transport network. Each of these categories has a different focus, where the missing link road network focuses on road network integration along with its status; while the missing link for public transport focuses on public transport connectivity, nodes, and activity centers.

1. The missing link road network is called missing if there is no road network connecting activity centers, national, local and environmental, as well as activity nodes.
2. Missing public transport links Disconnection of public transport at activity centers, nodes (terminals, ports, airports, stations) and TOD, as well as unconnected public transport integration can lead to transportation services general is not optimal and there are missing links

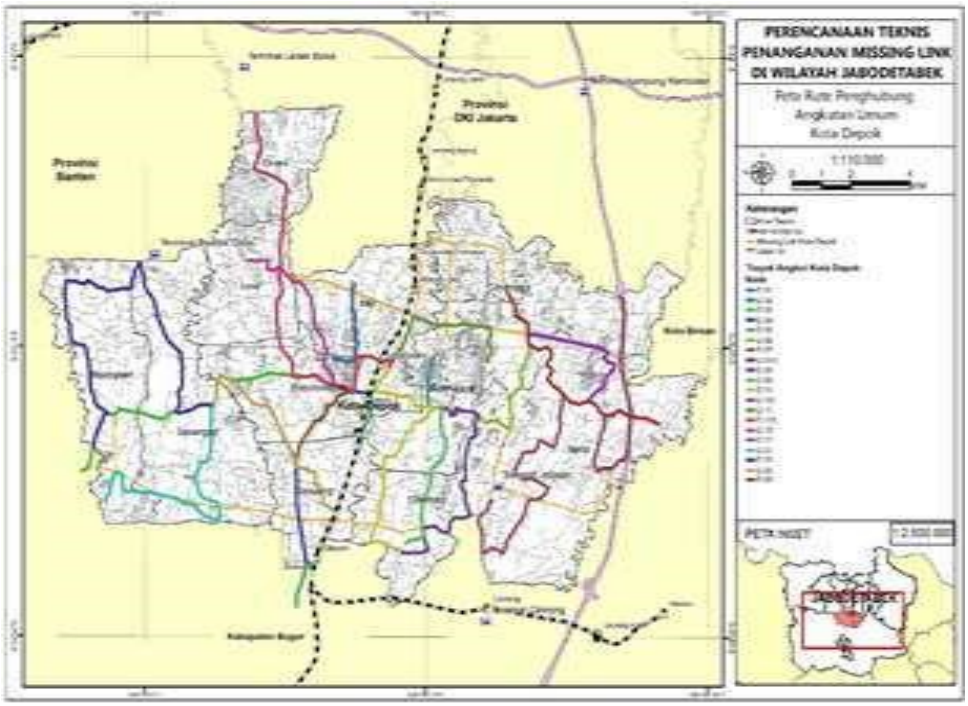

Figure 1. Missing link map for Depok Citiy.

Analysis of missing link in Depok City

The zone of origin and destination in the Depok City network model is based on sub-districts and a combination of several sub-districts. In this case there are 11 defined zones. This zone will later affect the modeling that will be carried out, especially for the matrix of origin and destination and demand for public transport (Budi Sitorus, 2013); (VMS, 2018). The following are the zones of origin and destination on the Depok City network.

Tablel 1. The zone of origin and destination for modeling the Depok City area.

No	Joint name of sub districts	Name of the district
1	Cinere	Depok City
2	Cimanggis	Depok City
3	Limo	Depok City
4	Sukma Jaya	Depok City
5	Beji	Depok City
6	Pancoran Mas	Depok City
7	Tapos	Depok City
8	Sawangan	Depok City
9	Cipayung	Depok City
10	Cilodong	Depok City
11	Bojongsari	Depok City

The missing link in the zone of origin and destination in question is if there is no connection to the public transport network in each zone of origin and destination zone, especially activity centers that will also be defined as PKN and PKW.

1. Area TOD (Transit Orientedvelopment)

Transit Oriented Development or Transit Oriented Development, which is abbreviated as TOD, is the concept of developing areas within and around mass public transportation nodes so that added value focuses on integration between mass public transport networks, and between mass public transport networks and non-motorized transportation mode networks, and reduction of motorized vehicles accompanied by the development of mixed, dense areas with moderate to high intensity of spatial use (Regulation of the Head of BPTJ No PR 377 / AJ.208 / BPTJ-2017).

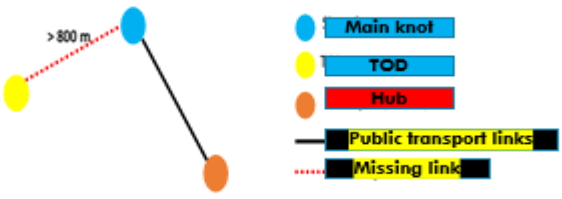

Figure 2. Ilustrasi of missing link in TOD

The TOD area will be said to have a missing link if the TOD has no connectivity with mass public transport nodes within a distance of more than 800 meters and is not on the main route for high

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capacity mass public transport. In this case, there are 2 TOD locations spread across the city of Depok as follows.

Table 2. TOD plan in Depok City.

No	TOD location plan	City/districts
1	Depok Baru	Depok City
2	Cinere	Depok City

2. Transportation Nodes

The main transportation node is said to have a missing link if there are no AKAP and AKDP transportation passing through that node.

The transportation nodes must be able to connect the TOD and at each of these transportation nodes, the availability and connection of public transportation to the activity center, TOD, and other transportation nodes will be seen to analyze whether there are missing links in these transportation nodes.

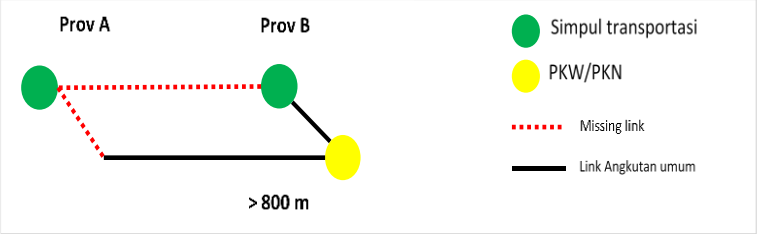

Figure 3. Ilustration missing link node.

3. Study area activity center.

Table 3. Activity center in the city of Depok

No	Centre	Regulation_City	Name
1	City Sevice centre	Depok City	Depok City
2	Sub city service centre	Depok City	Cinere
3	Sub city service centre	Depok City	Citayam
4	Sub city service centre	Depok City	Sawangan
5	Sub city service centre	Depok City	Cimanggis

The activity center is an area that serves activities in an area in relation to other areas on a certain scale. In this case, there are several types of activity centers, namely National Activity Centers (PKN) and Regional Activity Centers (PKW) and Local Activity Centers (PKL). The following are activity centers in Depok City:

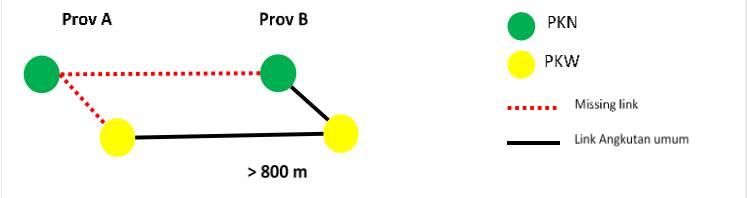

Figure 4. Ilustration of missing link activity center.

In this case there are 5 PKW (Regional Activity Centers) in the Depok City area as follows:

4. The AKAP route (Between cities between Provinces).

Table 4. Depok City transportation route

No	Route code	Route
1	D 01	Depok terminal-Depok I
2	D 02	Depok terminal-Depok II center/east
3	D 03	Depok terminal-Parung
4	D 04	Depok terminal-Beji-Kukusan
5	D 05	Depok terminal-Bojong Gede
6	D 06	Depok terminal-Pasar Cisalak
7	D 07	Depok terminal-Pitara-Rawa Denok
8	D 07A	Depok terminal-Pitara-Citayam
9	D 07A	Depok terminal-Pitara-Citayam
10	D 08	Depok terminal-BBM-Kp. Sawah
11	D 09	Terminal Depok-Studio Alam-Kp. Sawah
12	D 10	Depok terminal-Parung Serab-Kp. Sawah
13	D 11	Depok terminal -Akses UI-Palsi Gunung
14	D 15	Depok terminal-Jl.R. Sanim-Simpang Limo
15	D 21	Sawanga-Duren Seribu
16	D 25	Bedahan-Sawangan-Curug-BSI
17	D 26	Sub Sawangan terminal-Citayam
18	D 17	Jatijajar-Banjaran Pucung-Tapos
19	D 107	Ps.Cisalak-Gas Alam- Leuwinanggung
20	D 69	Ps.Cisalah-Pekapuran-Bayunan
21	D 110	Terminal Depok-Cinere

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Intercity and Interprovincial Transportation is public transportation that serves trips from one city to another city with different provinces. In this case, AKAP transportation generally uses the bus mode with rates that vary depending on the distance from the origin and destination cities. AKAP usually leads to a type A terminal in an area and has the last stop at terminal A as well. AKAP routes are detailed in the attachment.

Table 5. The AKAP route in the area.

No	Routes	Type
1	Blok M-Cinere	AKAP
2	Blok M-Depok	AKAP
3	Lebak Bulus-Depok	AKAP
4	Pondok Labu-Depok	AKAP
5	Grogol-Depok	AKAP
6	Sawangan terminal-Ciputat	AKAP
7	Depok-Kp.Rambutan	AKAP
8	Simpangan Depok-Kampung Rambutan	AKAP
9	Depok Timur-Kp. Rambutan	AKAP
10	Depok-Kp.Rambutan	AKAP
11	Kp. Rambutan-Depok	AKAP
12	Depok-Bandara Halim Perdana Kusuma	AKAP
13	Mayasari Bakti AC84 Pulo Gadung-Depok	AKAP
14	Jatijajar terminal-leuwinanggung	AKAP

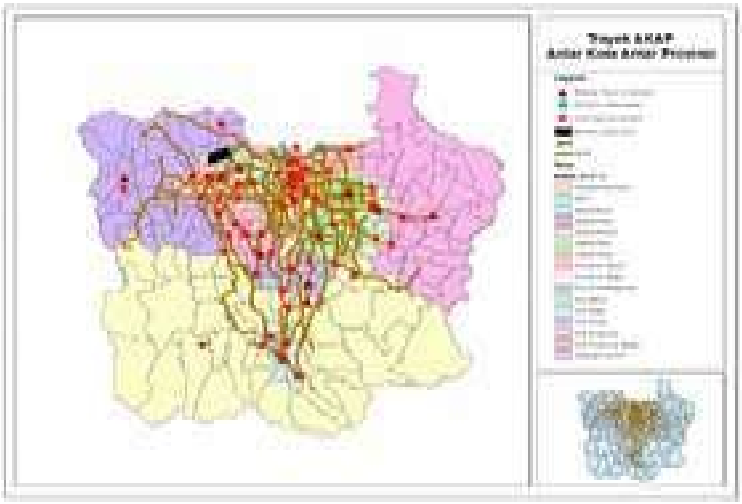

Figure 5. Jabodetabek AKAP routes.

From the figure below, it can be seen that AKAP routes in the Jabodetabek area have mostly served activity centers in Jabodetabek and TOD, but there are several node locations, especially terminal A which have not been served by AKAP.

5. Depok city transportation route.

Depok city transportation route is in the form of public transportatioj with rates that vary according to the distance traveled. There are 21 transportation routes for Depok City. The following is the transportation route for Depok City.

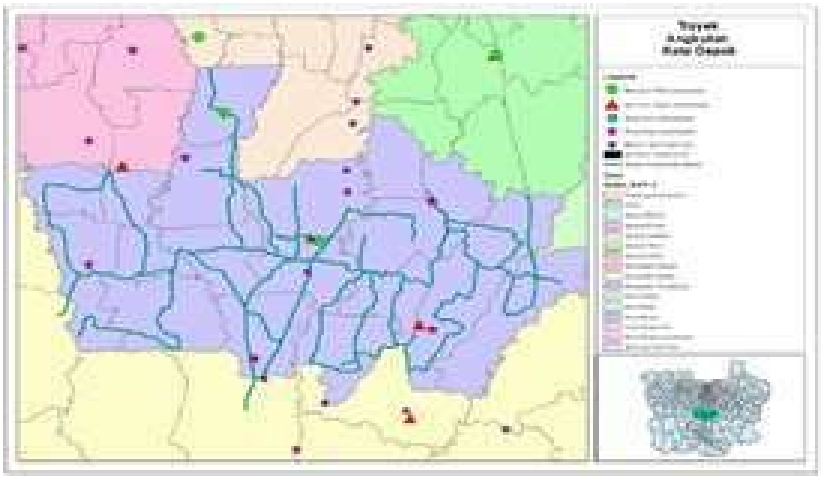

Figure 6. Depok City Transportation Route Map.

Discussion of Missing Road Network Links.

In general, the road network in Jabodetabek has connected activity centers, national, local, and environmental. The target speed that has been set, with a special value for Jabodetabek is a minimum network speed of 20 km / hour. On average, based on the modeling results that have been submitted, the Jabodetabek average network speed has met the target. However, if it is examined in more detail per road function, with the minimum speed criterion for arterial and collector roads being 40 km / hour, a more detailed review is carried out on the speed between regions and within the lowest district / city in Depok City. Tangerang Regency and Bekasi Regency had the lowest speed, with the lowest values being 25.06 km / hour and 25.39 km / hour. This indicates the need to increase the capacity of the road network to and from Tangerang District and Bekasi District. For Depok City, information on the average speed that occurs in the city is 28.81 km / hour, so it is necessary to increase the capacity of the road network in Depok City.

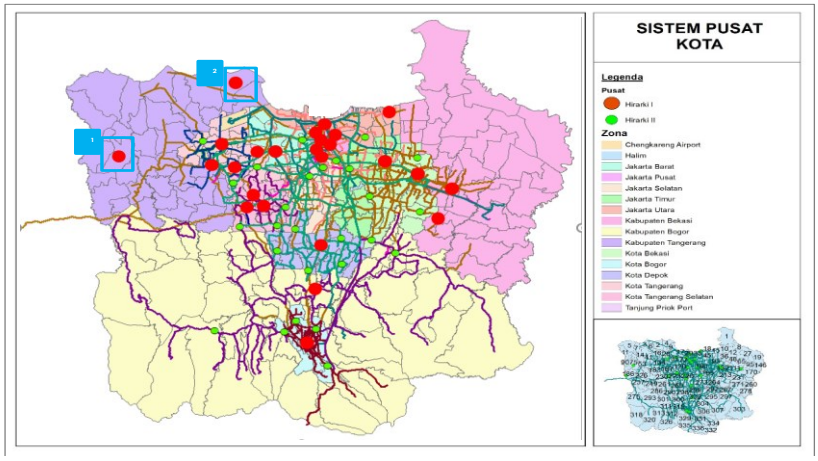

Figure 7. Activity center for public transport and its integration into nodes.

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Table 6. Closest TOD distance

TOD namely and distance closest	Range
TOD Cinere – Fatmawati station	6,1 km

Analysis of Missing Link Activity Center.

From the picture above, it can be seen that there are 5 PKNs that are not connected by public transportation to other PKNs and are not connected to PKW in the same city. one PKN is not connected at all by public transport routes, resulting in a missing link. The one PKN is:

1. Cinere sub-district, Depok city.
2. Citayam sub-district, Depok city.
3. Sawangan sub-district, Depok city.
4. Cimanggis sub-district, Depok city.
5. Depok city.

For PKN one, Kecamatan Tapos, if you want an addition of public transportation routes, preferably connecting PKN Tapos with other PKNs in other cities / districts (at least the closest), for example public transportation routes that connect PKN Tapos with PKN Depok City or, add public transport routes that can be directly connected from PKN Tapos with the train station. In addition, it can be done rerouting the nearest public transport or recommended routing of public transportation close to the train route. In addition, routing can also be done for the following routes: AKAP Jatijajar terminal

Table 7. Ilustration of connectedness to national activity centers.

PKN	PKN – PKN (No mass public transportation)	Range
PKN Cimanggis	PKN Cimanggis–AKAP (Terminal Jatijajar–Depok city)	12 km

Missing link analysis for the TOD region

In the first criterion, the distance between the TOD and the transportation node is a maximum of 800 meters. From the images and analysis of the 800 meter buffer for TOD that has been carried out, it can be seen that there are still several TODs that are more than 800 meters from the transportation node, namely:

1. Cinere

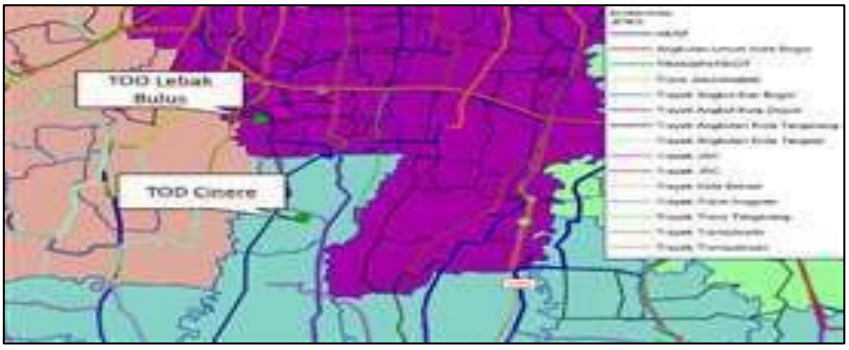

Figure 8. The distance of the TOD and the closest node.

Transportation Node Missing Link Analysis.

The main transportation node is said to have a missing link if it is not connected to the AKAP and / or AKDP public transport routes. The following is a map of public transport routes that have been previously identified along with transportation nodes.

From the picture above there is one node that is not at all integrated with public transport, namely Terminal type A Jatijajar. Where this terminal is not connected to public transportation at all, this terminal is located between the nearest public transport route.

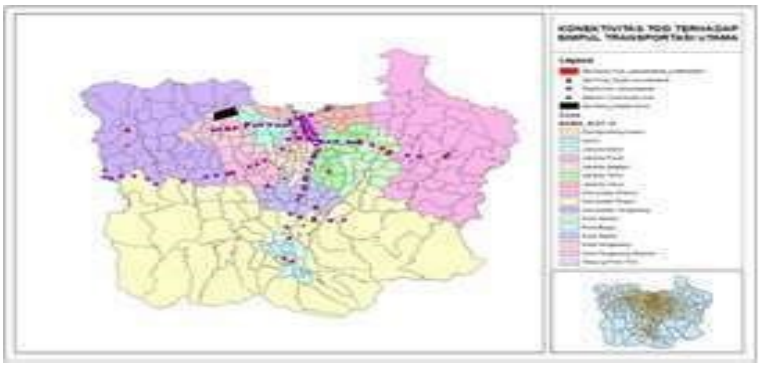

Figure 9. Transport routes in the Jabodetabek area.

Table 8. Missing links and recommendations for public transport networks

Missing Link on:	Criteria	Existence of the Missing Link		The Missing Link Description	City/District
Network	Network speed.	Road network to Tangerang Regency and Bekasi Regency.	Road Network in Depok City.	Has the lowest speed compared to other speeds and existing road functions.	Tangerang Regency, Bekasi Regency and Depok City
Hub	In the inner city network, PKN and PKW are not connected	Cimanggis District, Depok City	PKN Cimanggis-AKAP (Jatijajar Terminal-Depok City) (12 km)	There is no connection between PKN Cinere, Citayam, Sawangan, Cimanggis and PKN Depok City	Depok City
TOD	First, the distance between the TOD and the transportation node is a maximum of 800 meters	TOD Cinere	TOD Ciinere-Stasuin Fatmawati (6.1 km)	The distance of the TOD and transportation nodes is more than 800 meters.	Depok City

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Recapitulation of Missing Link of Road Network and Public Transport.

Based on the definitions described and the analysis that has been carried out, the following is a recapitulation of missing links and recommendations for road networks and public transport.

Priority for Route Handling.

Based on the definitions that have been described and the analysis that has been carried out, the following is a recapitulation of missing links and recommendations for road networks and public transportation. After being carried out on 6 routes, the following are priorities for existing routes that must be improved services, such as additional schedules or bus fleets.

Table 9. Priorities for handling existing routes.

No	Routes	Type of mode	Route length (km)	Final score
1	Univ. Indonesia-Lebak Bulus	Trans Jabodetabek	13.4	0.61
2	Depok-BKN	Trans Jabodetabek	23.04	0.54
3	Stasiun Manggarai-Univ. Indonesia	Trayek Transjakarta	15.77	0.56
4	Terminal Sawangan-Ciputat	AKAP	34.89	0.52
5	Depok Timur-Kp. Rambutan	AKAP	11.07	0.51
6	Terminal Jatijajar – Leuwinaggung	AKAP	8.54	0.49

For the route, it is proposed to connect between Sawangan and Ciputat Terminals. Meanwhile, the proposed city of Depok does not connect.

Table 10. Movement of public transport (pnp/day)

Origin/ Destination	West Jakarta	Central Jakarta	South Jakarta	East Jakarta	North Jakarta	Bekasi District	Bogor District	Tangerang District	Bekasi City	Bogor City	Depok City	Tangerang City	South Tangerang City	Generation Total (pnp/day)
Depok city	8,130	4,698	9,364	14,474	4,655	22,035	55,971	12,306	8,141	1,967	299,490	3,815	2,356	447,402

Table 11. Movement of private vehicles (vehicle/day)

Origin/ Destination	West Jakarta	Central Jakarta	South Jakarta	East Jakarta	North Jakarta	Bekasi District	Bogor District	Tangerang District	Bekasi City	Bogor City	Depok City	Tangerang City	South Tangerang City	Generation Total (pnp/day)
Depok city	746	809	1,015	1,806	420	2,550	6,645	925	781	180	32,926	711	849	50,363

Table 12. Speed R

Origin/ Destination	West Jakarta	Central Jakarta	South Jakarta	East Jakarta	North Jakarta	Bekasi District	Bogor District	Tangerang District	Bekasi City	Bogor City	Depok City	Tangerang City	South Tangerang City
Depok city	38,48	37,44	32,98	36,85	40,93	25,39	34,92	25,06	26,16	44,95	28,81	26,82	32,19

Weighting and priority handling of routes / subsidies

In order to obtain the priority order of handling existing routes and subsidies for new routes, weighting is made of each route factor and criteria. The weighting is obtained from the average value divided by variation. Thus, even though it has a high average value, there is a greater reduction in weighting with a wider range of variations.

weighting on each of the factors and criteria. Mathematically, the calculation of the priority value for both existing and non-existing routes will be obtained by the equation:

$$(Route)_i = W_1(W_{11}\,X_{11} + W_{12}\,X_{12} + W_{13}\,X_{13} + W_{14}X_{14} + W_{15}\,X_{15} + W_{16}\,X_{16}) + W_2(W_{21}\,X_{21} + W_{22}\,X_{22} + W_{23}\,X_{23} + W_{24}X_{24} + W_{25}\,X_{25}) + W_3(W_{31}\,X_{31} + W_{32}\,X_{32}) + W_4(W_{41}\,X_{41} + W_{42}\,X_{42})$$

Based on this, this is done in public vehicles by making direct calculations to passengers, in order to obtain the characteristics of passenger travel with public vehicles on a route.

The purpose of this survey is to collect data related to the description of public transport services, including:

1. Origin and destination of passengers on each route.
2. The number of passengers who make a transfer in one trip for each route.
3. Other modes used before and after.

This can be done by multiplying the interview data by an expansion factor. The expansion factor is obtained by the formula:

$$\text{Expansion Factor} = \frac{A}{B}$$

Information:

A = The total number of passengers carried by a public vehicle in one route (population).

B = Number of samples of passengers who were successfully interviewed from the same route.

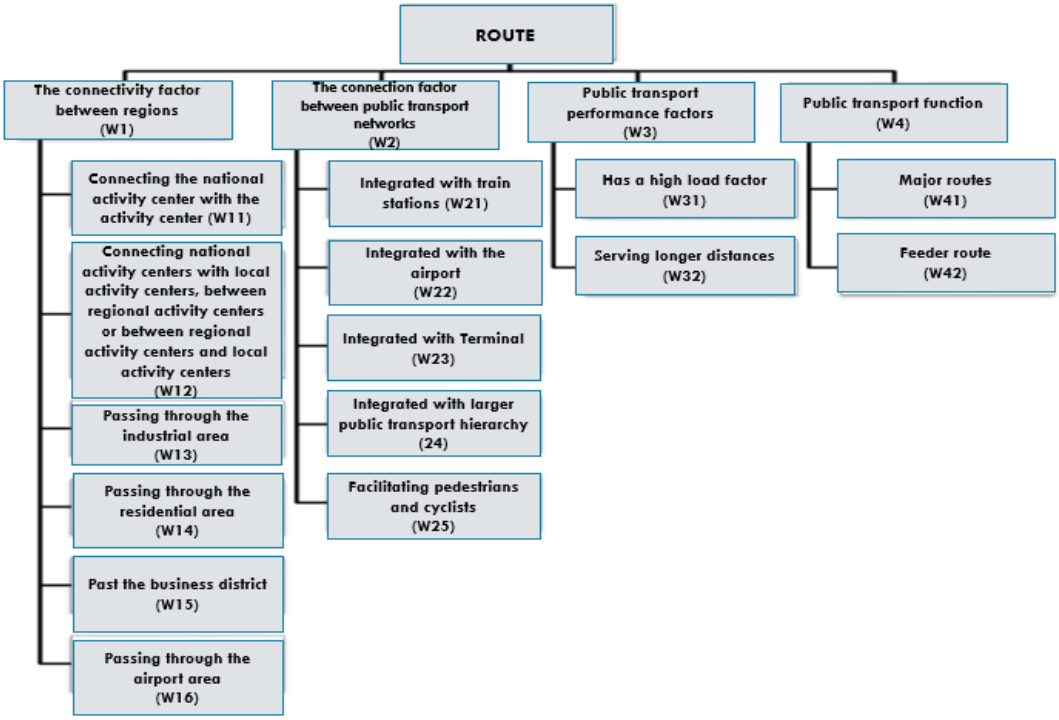

Figure 10. Weighting of the existing route.

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CONCLUSION

From data analysis and data processing to data analysis and discussion, a study on missing link technical planning in the Jabodetabek area can be concluded as follows in, travel speeds between cities / regencies in Jabodetabek do not reach the target speed of 40 km/hour. And the speed between regions and within the district / city in the city of Depok. Tangerang Regency and Bekasi Regency had the lowest speed, with the lowest values being 25.06 km/hour and 25.39 km/hour. So it is necessary to increase the capacity of the road network to and from Tangerang Regency and Bekasi Regency. For the city of Depok, the average speed that occurs in the city is 28.81 km/hour, so it is necessary to increase the capacity of the road network in the city of Depok. The TOD area will have a missing link if the TOD has no connectivity with mass public transport nodes located at a distance of more than 800 meters and not on the main route for high capacity mass transportation, such as the Cinere TOD. There is PKN that is not connected by public transportation to other PKN and is not connected to PKW in the same city, namely Cimanggis District, Depok City. The technical planning needed to solve the problem of missing links in the Depok City area can be grouped into the categories of missing link road networks, activity centers, TOD areas, and transportation nodes as well as general transportation service networks.

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