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Measuring the Efficiency of the Wira Wiri Feeder Network in Relation to the BRT Plan in Surabaya City

Nyoman Chandrikania Utama[1], Siti Nurlaela[✉2], Eko Budi Santoso[3]
[1]Urban and Regional Planning Sepuluh Nopember Institute of Technology, Surabaya, Indonesia

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✉nurlaela@its.ac.id

Abstract: Surabaya faces challenges in providing efficient and integrated public transportation, including traffic congestion and limited-service effectiveness. To address this, the government plans to implement a Bus Rapid Transit (BRT) system as the main transit line, integrated with the Wira Wiri feeder network. This integration aims to enhance route efficiency and reduce travel time. Efficient routing in such systems helps lower operational costs, improve accessibility, and benefit both users and operators. This study analyzes the efficiency of the Wira Wiri feeder routes before and after BRT implementation. Using a positivist, quantitative approach, the research applies two key metrics: node connectivity (measuring the connection between stops) and line connectivity (assessing the continuity of individual feeder routes). The results will compare the feeder network's efficiency before and after integration into the BRT system. The integration of the Wira Wiri feeder system with Surabaya's planned BRT network shows strong potential to improve public transport efficiency. Simulated connectivity analyses indicate significant increases in node and line connectivity, leading to better accessibility and reduced travel time across urban sub-districts. These findings highlight the importance of implementing the BRT network to support inclusive, sustainable, and integrated urban mobility.

Keywords: Value of Travel Time Saving; Wira Wiri Feeder; BRT Surabaya; Public Transport; Network Efficiency.

1. Introduction

The existence of public transport has a significant impact on people's lives, such as the movement of people that causes urbanization. The increasing rate of urbanization is a challenge for the government to meet the needs of transportation infrastructure. Transport infrastructure is closely related to public transport networks. An efficient public transport network has an impact on reducing travel time, transport demand, reducing operational costs and reducing carbon emissions generated by transport (Melo et al, 2024). Public transport networks typically implement trunk and feeder systems to meet high transport demand (trunk) and connect low-density areas to the trunk network (feeder). The Indonesian Ministry of Transport emphasizes the development of public transport services that are inseparable from the development of trunk and feeder systems. While the feeder system or passenger transport system acts as a first mile and last mile by using smaller and flexible public transport, the trunk system serves as the main corridor, providing high capacity, long distance transport along primary urban routes. The application of trunk and feeder systems in the development of public transport networks triggers intermodal integration to meet the travel needs of the community more efficiently.

Urban public transport has several challenges in time efficiency, one of which is traffic congestion which triggers an increase in operational costs for public transport services (Ritonga et al, 2015). Improving the mass transit system can be done by integrating various modes of public transportation and implementing subsidy policies to encourage modal shift to transportation (Sitorus, 2019). The development of mass public transport that has dedicated lines such as BRT, MRT, and LRT will affect the improvement of public transport service performance in terms of reliability and travel time savings. With such a system, the public transport system has a higher attractiveness and can compete well with other public transport (Graham et al., 2014). Improved route efficiency in public transport networks has been developed by several cities in the world such as Yichang City in China, Belo Horizonte in Brazil and Bogota in Colombia (The BRT Standard, 2016). Yichang City has a BRT with a direct service system and benefits from the continuous addition of bicycle lanes and the planning of a bike share system aimed at improving access. In addition, the MOVE BRT in Brazil is connected to the city center which has a high demand for public transport. Last, the TransMilenio BRT located in Bogota, Colombia has a high capacity. All three of them are supported by the integration of feeder systems to support community travel. Based on the best practices, this supports the integration of public transportation between trunk and feeder systems.

The BRT system is one of the transportation systems with low infrastructure costs (Devi et al., 2022). This is supported by the government allocating 382 billion rupiah for BRT development in 6 agglomeration cities, namely Mebidangro, Jabodetabek, Bandung Metropolitan, Surabaya, Sarbagita, and Mamminasata (Ministry of Transportation of the Republic of Indonesia, 2014). This study is inspired by the need to evaluate improvements in route and stop efficiency when a new public transportation system is added to an existing one. Such evaluation is essential for identifying the necessary enhancements in multimodal integration to ensure cohesive and efficient public transport services. This discussion is contextualized through a case study in Surabaya, which has been designated as one of the priority metropolitan cities in Indonesia for the development of a sustainable urban transportation system.

Surabaya, a major metropolitan city in Indonesia, continues to develop its public transportation system to address urban challenges. Initiatives such as the Suroboyo Bus, Trans Semanggi, and Wira Wiri Feeder represent efforts to implement a trunk and feeder model. However, despite these service, public transport usage remains low, with only around 2500 Wira Wiri passengers per day out of a population exceeding 3 million (Alfiansyah, 2024). This gap is largely due to time inefficiencies, particularly in high activity areas like hospitals, schools, and travel hubs (Pojani et al, 2015) the planned integration of a BRT system with the existing feeder network presents a strategic opportunity to enhance route efficiency, reduce travel time, and increase public transport appeal.

Route efficiency in the transportation network has a significant impact on increasing passengers (Kreindler et al., 2023). Based on this research, it is shown that increasing the frequency of transportation can increase the number of passengers. An increase in ridership of public transportation will affect the perception of service quality, such as in terms of accessibility, reliability, and comfort (C40 Knowledge, 2021). Therefore, route efficiency supported by the integration of BRT with Feeder can facilitate users in traveling so as to increase user comfort. Through the integration of public transportation with reduced operating costs, it indirectly affects the increase in revenue as operators can allocate more needed resources. This supports that the efficiency of Feeder routes with BRT can improve transportation services, revenue and sustainability of the public transportation system in the long term.

Based on this description, it shows that an efficient public transportation network is related to intermodal integration supported by infrastructure financing in accordance with policies. This encourages performance in the public transportation network so that it affects travel time savings. Therefore, the author conducted a study entitled "Assessment of the Value of Time from Increasing the Efficiency of the Wira Wiri Feeder Route to the BRT Plan in Surabaya City" to determine the significance of BRT development in increasing the efficiency and integration of mass public transport routes in Surabaya City with travel time savings indicators that will contribute to tariff setting optimization and other economic impacts.

2. Method

The research approach is defined as a scientific method or way to collect information in accordance with the research objectives (Hamid Darmadi, 2013). In the context of this research, the approach adopted is a positivistic approach. The positivistic approach is an approach that is often used to view things objectively and in accordance with the data obtained. In addition, this approach is defined as a method based on the philosophy of positivism or views reality that can be clarified and the relationship between symptoms is causal. This approach is generally used in quantitative research.

The type of research used in this research is quantitative research. This research uses some data sourced from primary and secondary data collection that is measured in numbers or numerical. This research uses a variety of quantitative methods used to identify improvements in connectivity performance of stops that have Wira Wiri Feeder services both before and after the BRT plan in Surabaya City.

2.1. Research Variables

A research variable is something that is analysed to find out information for research and get conclusions from it. The variables used in this study consist of two indicators, namely the characteristics of public transportation integration and network profiles. Indicators in knowing the characteristics of public transportation integration include: (1) type of public transportation operating; (2) physical integration or physical route integration as measured by the length and number of routes and the number of stops operating; and (3) vehicle capacity. While the network profile indicator in this study is used to determine how the shape of the network used in the public transportation system in Surabaya City.

2.2. Data Collection

This research uses two types of methods in data collection, namely primary and secondary surveys. The data collection method or primary survey is a stage in data collection to find data and information carried out directly through respondents in the field. Some ways in primary surveys can be done as follows.

- Field observation

  Field observation is carried out by looking at field conditions in fact. The observations mentioned in this article are carried out by documenting the conditions of the bus stops that are the stops of the Wira Wiri Feeder service and are included in the BRT plan. In addition, this observation can be done by looking at google maps to see the distribution of land use in the catchment of each bus stop.

Secondary survey is a data collection stage carried out by reviewing several documents, namely land use maps, public transportation network maps, public transportation service profiles (frequency, headway, route length, etc.), and literature from several journals that have similar topics. In addition, some of the secondary data collected is some data owned by government agencies such as the Surabaya City Transportation Agency.

2.3. Data Analysis

This study uses node connectivity and line connectivity analysis techniques to identify how the connectivity performance of several stops that have Feeder Wira Wiri services improves both before and after integration with the BRT plan. Node Connectivity refers to the capability of a bus stop on a public transportation route, namely the Wira Wiri Feeder. The formulas and analytical framework for both node and line connectivity in this study are adapted from the methodology proposed by Hilal et al. (2024), which focuses on assessing public transport integration and spatial efficiency in urban transit networks.

$$P_{l,n}^{0} = \alpha C_l \times \beta V_l \times \gamma D_{l,n}^{0} \times A_{l,n} \qquad (1)$$

Description:

$P_{l,n}^{0}$	= total connectivity of route "l" at node "n"
C_l	= average passenger capacity of route "l"
V_l	= average speed of route "l"
$D_{l,n}$	= number of outgoing connections from node "n"
$A_{l,n}$	= density of the zone traversed by path "l" at node "n"
α, β, γ	= scale factor

The next analysis uses line connectivity which refers to the ability of the network or route of the Wira Wiri Feeder service to maintain connections between lines despite interruptions on some lines.

$$\theta_l = (|S_i| - 1)^{-1} \sum P_l^{0} \qquad (2)$$

Description:

θ_l	= total connectivity of route "l" at node "n"
S_i	= number of nodes that route "l" and/or stop "l" passes through
P_l^{0}	= number of connectivity nodes that route "l" passes through

The node connectivity and line connectivity values will be categorized into 5 categories namely: (1) Low; (2) Medium; (3) High; (4) Busy; and (5) Very Busy. Category (1) starts from 0 to 2.5, category (2) starts from number 2.5 to 5, category (3) starts from number 5 to 10, category (4) starts from number 10 – 20, and category (5) includes node connectivity index more than 20. These five categories will be used as a comparison of the connectivity of Wira Wiri Feeder stops and routes both before and after integration with the BRT plan.

3. Results and Discussion

3.1. Overview

Surabaya has several public transportation routes, namely Suroboyo Bus, Trans Semanggi and Wira Wiri Feeder. In 2018, the Surabaya City Government launched Suroboyo Bus which is a modern bus transportation services intended as public transportation like city buses in the metropolitan area of Surabaya City. This service was launched by the city government with the initial corridor being a series of loop corridors R1-R2 on the Purabaya Terminal – Rajawali route. The Suroboyo Bus service was managed by the Surabaya City Transportation Agency in the form of UPTD Public Transportation Management in 2019. The service was then upgraded to a Regional Public Service Agency in 2021 to optimize services by adding payment options using electronic money. Along with this addition, there was also an upward trend in the number of passengers obtained.

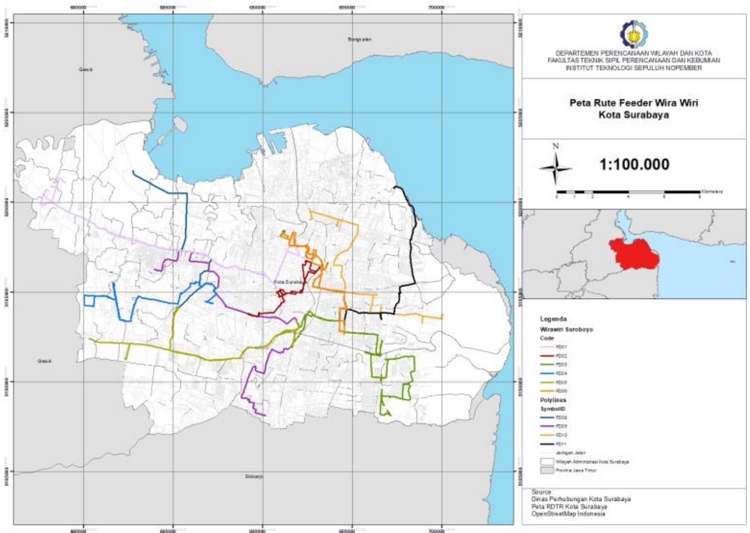


Figure 1. Existing Route Map of Wira Wiri Feeder in Surabaya City
Source: Surabaya City Transportation Department, 2025

Figure 1 illustrates the existing route network of the Wira Wiri Feeder system in Surabaya City. This map shows the distribution and service coverage of various feeder routes, which are spread across several areas of the city. Each route is represented by a different color, indicating the specific corridors served by the feeder lines in different sub-districts. It can observe that most routes are concentrated in the central and western parts of Surabaya, reflecting a focus on areas with high population density and activity. Some routes show overlapping or intersecting paths, potentially indicating suboptimal network efficiency. This information is particularly relevant for identifying strategic nodes that require improved connectivity to support more efficient travel times and enhance public transport accessibility.

3.2. Identification of Connectivity Performance Improvements of Wira Wiri Stops and Routes Before and After the BRT Plan

The identification of the performance improvement of Wira Wiri feeder stop and route connectivity includes several data, namely the number of active modes, mode capacity, route length, feeder route type and travel time. The mode capacity of a feeder is measured by the size of the feeder mode. The mode capacity supports in accommodating passengers in one mode. The number of modes is the total vehicle units prepared to serve one route. Route length or the total distance from the starting point to the end point on one feeder route. While travel time is the total travel time required for a route to complete one trip.

Tabel 1. Identification of Wira Wiri Feeder Services in Surabaya City in 2025

Route		Daily Capacity (Average)	Number of Modes	Route Length (km)	Travel time (minutes)
FD1	Terminal Benowo – Tunjungan	1565	16	22.8	73
FD2	Mayjen Sungkono – Balai Kota	306	7	8.3	39
FD3	TIJ – Gunung Anyar	866	14	20.6	108
FD5	Taman Puspa Raya – Mayjen Sungkono	210	8	13.6	82
FD6	TIJ – Lakarsantri	1227	17	19.5	69
FD7	Terminal Bratang – Stasiun Pasar Turi	634	7	11.6	69
FD8	UNESA – Terminal Osowilangun	185	4	14.0	82
FD9	Terminal Menanggal – Terminal Manukan	597	8	25.7	117
FD10	Terminal Keputih – Bunguran	187	6	19.1	73
FD11	Terminal Bratang – Shelter Bulak	151	5	14.2	109

Source: UPTD PTU Transportation Department of Surabaya City, 2025

- Node Connectivity

  Analysis of the node connectivity index through calculations using Microsoft Excel by analyzing each route that passes through a node. This analysis aims at how the connectivity of stops on a route both before and after the BRT. Analysis of node connectivity after the BRT requires some data such as daily capacity, number of routes and number of modes used in public transportation services routes. However, Surabaya's BRT is not yet in operation, so this research takes an example of BRT implementation in Jakarta City, namely Transjakarta and JakLingko. Based on the Transportation Steering Committee Report related to DKI Jakarta Evaluation (Dishub & JakLingko), the number of Transjakarta passengers increased from 40 thousand passengers to around 90-100 thousand passengers per day. This shows an increase in the number of passengers by 100% of the total passengers post the integration with the feeder system or JakLingko.

  Therefore, the percentage increase in the number of passengers or daily capacity of Transjakarta is the basis for calculating the connectivity value of each bus stop after being integrated with the Surabaya BRT. Some of the variables used in this analysis are the number of routes, number of modes, and total daily capacity of a route after being integrated with BRT.

Table 2. Node Connectivity Index Before and After BRT

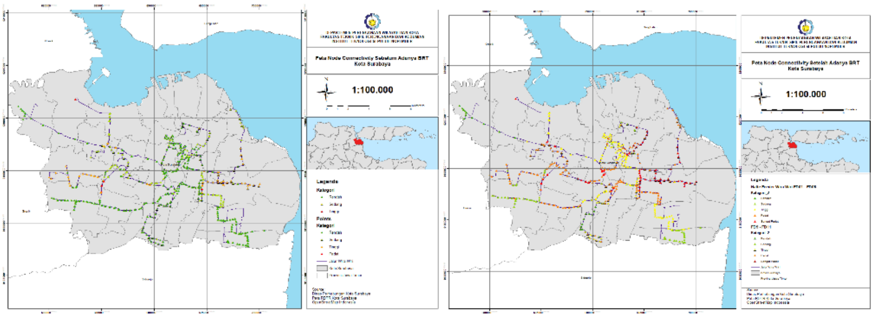
Zone	Wira Wiri Stop	Before			After			Percentage
		Index NC	Number of Passing Routes	Category	Index NC	Number of Passing Routes	Category	
Asemrowo	Margomulyo Indah A	3.69	1	Moderate	7.37	1	High	99.70%
Benowo	Polsek Benowo A	0.75	2	Low	2.26	6	Low	201.33%

Zone	Wira Wiri Stop	Before			After			Percentage
		Index NC	Number of Passing Routes	Category	Index NC	Number of Passing Routes	Category	
	Terminal Tambak Osowilangun	11.62		Busy	34.87		Very Busy	200.16%
Bubutan	Stasiun Pasar Turi	1.46	1	Low	8.04	11	High	450.68%
Bulak	Kenpark	2.78	1	Moderate	12.51	9	Busy	350%
Dukuh Pakis	Darmo Park 1	3.88	4	Moderate	23.29	12	Very Busy	500%
	Pasar Modern Darmo Permai B	1.81		Low	10.87		Busy	500%
	Jogoloyo A	0.85		Low	5.11		High	501%
	Jono Soewojo 1	3.62		Moderate	21.74		Very Busy	500%
Gayungan	SMAN 15	1.33	1	Low	5.33	8	High	300%
Genteng	Tunjungan	0.55	3	Low	4.40	3	Moderate	700%
	Balai Kota	2.52		Moderate	11.98		Busy	375%
	Cak Durasim A	1.26		Low	6.39		High	407%
Gubeng	UBAYA Ngagel	2.43	4	Low	10.82	4	Busy	345%
	Raya Gubeng	1.62		Low	9.74		High	501%
	Karang Menjangan A	1.89		Low	11.36		Busy	501%
	Terminal Bratang	3.08		Moderate	19.95		Busy	547%
Gunung Anyar	SWK Gunung Anyar B	1.27	1	Low	2.96	7	Moderate	133%
Jambangan	Universitas Merdeka A	1.20	1	Low	1.20	2	Low	0%
Karangpilang	Gemol A	1.20	1	Low	2.99	5	Moderate	149%
Lakarsantri	SWK Lakarsantri	1.13	2	Low	3.97	7	Moderate	251%
	UNESA	5.95		High	14.89		Busy	150%
Mulyorejo	Menur A	4.71	3	Moderate	30.63	13	Very Busy	550%
	Samsat Manyar	5.50		High	35.74		Very Busy	549%
	Sutorejo Indah A	6.60		High	42.89		Very Busy	549%
Pabean Cantian	Pasar Atom Mall	1.97	1	Low	8.84	9	High	348%

Zone	Wira Wiri Stop	Before			After			Percentage
		Index NC	Number of Passing Routes	Category	Index NC	Number of Passing Routes	Category	
Pakal	Griya Surabaya Asri	0.38	1	Low	0.95	5	High	150%
Rungkut	Rektorat UPN A	2.43	1	Low	9.72	8	High	300%
Sambikerep	Pakuwon Indah A	6.90	1	High	12.18	4	Busy	76%
Sawahan	Pasar Kembang A	1.21	3	Low	7.87	13	High	550%
	PNR Mayjen A	5.19		High	28.52		Very Busy	449%
	Gedung Juang 45	2.42		Low	15.73		Busy	550%
Simokerto	Graha Adyatama	1.19	1	Low	4.76	8	Moderate	300%
Sukolilo	UNTAG A	3.00	4	Moderate	16.48	11	Busy	449%
	Taman Flora	17.38		Busy	69.52		Very Busy	300%
	Medical Center ITS	6.99		High	38.45		Very Busy	450%
	ITATS	8.39		High	46.15		Very Busy	450%
Sukomanunggal	Tanjungsari A	1.85	4	Low	8.34	9	High	350%
	HR Muhammad 1	3.71		Moderate	16.67		Busy	349%
	Pasar Modern Darmo Permai A	7.41		High	33.35		Very Busy	350%
	Kejaksaan Negeri Surabaya A	3.71		Moderate	16.67		Busy	349%
Tambaksari	Stasiun Gubeng Baru	3.31	2	Moderate	21.49	13	Very Busy	549%
	Universitas Airlangga A	3.86		Moderate	25.07		Very Busy	550%
Tandes	Manukan Kulon A	1.95	5	Low	7.79	8	High	299%
	Polsekta Tandes A	3.90		Moderate	15.58		Busy	299%
	Samsat Tandes 1	9.74		High	29.21		Very Busy	199%
	Sentong Asri A	7.79		High	31.16		Very Busy	300%
	Terminal Manukan	3.90		Moderate	15.58		Busy	299%

		Before			After			
Zone	**Wira Wiri Stop**	**Index NC**	**Number of Passing Routes**	**Category**	**Index NC**	**Number of Passing Routes**	**Category**	**Percentage**
Tegalsari	Embong Malang	0.78	2	Low	5.05	13	High	547%
	Kartini	1.78		Low	11.54		Busy	548%
Wiyung	PTC B	17.49	3	Busy	52.49	9	Very Busy	200%
	Graha Sampoerna Indah A	2.37		Low	10.68		Busy	350%
	Bundaran UNESA	12.45		Busy	43.59		Very Busy	250%
Wonokromo	Banyu Urip Wetan	2.25	4	Low	22.47	20	Very Busy	898%
	Terminal Intermoda Joyoboyo	2.05		Low	18.44		Busy	799%
	Joyoboyo 2	2.90		Moderate	26.03		Very Busy	797%
	SMPN 32	1.97		Low	19.66		Busy	897%

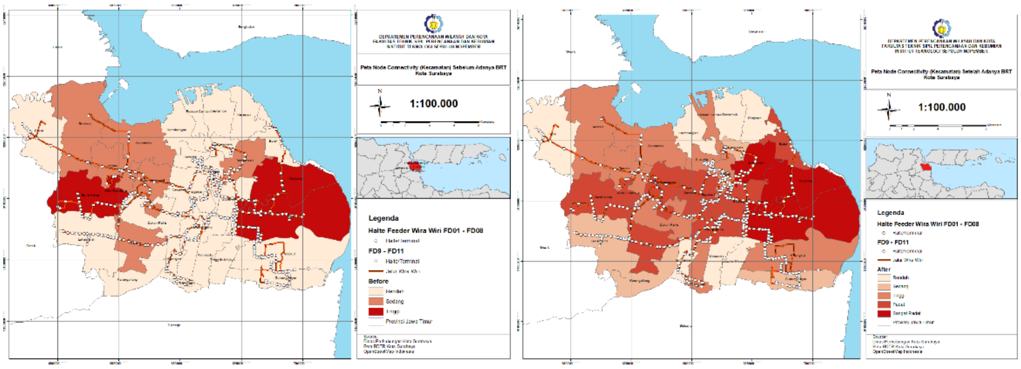
Based on the results of the node connectivity analysis both before and after the BRT, it can be concluded that the integration of Wira Wiri with BRT will increase the node connectivity of each public transportation node or stop in Surabaya city. Some of the stops that have increased connectivity in the provision of public transportation services are Taman Flora, PTC B, and ITATS stops with a very busy level of connectivity. The connectivity index of the three stops is classified as stops with high connectivity even before being integrated with BRT services. After being integrated with the BRT plan, the three stops experienced an increase in connectivity so that they became stops with very busy connectivity. This is supported by the fact that the number of routes in one zone or sub-district increases following the BRT development plan in Surabaya. The increase in the node connectivity index is also supported by the number of modes and daily capacity of each route so that route efficiency increases.



(a) **(b)**

Figure 3. Node Connectivity Map (a) Before BRT Implementation, (b) After BRT Implementation
Source: Author's analysis, 2025

Figure 1 shows the changes in node connectivity before and after the implementation of the BRT plan Surabaya. The map on the left shows that all most nodes were previously classified with low to moderate level in node connectivity, that indicated by green and yellow nodes. After the BRT plan, as seen on the right map, there is significant expansion of nodes with high to very busy level in node connectivity, shown in red and orange nodes. This visual evidence highlights a substantial improvement in the distribution and integration of the public transportation network. The BRT plan successfully enhances accessibility across a wider urban and also the connectivity and efficiency of Wira Wiri Feeder routes, especially in central and eastern parts of the city, indicating better service coverage and more efficient route connections.



(a) (b)

Figure 2. Node Connectivity Map by Sub-District: (a) Before BRT Implementation, (b) After BRT Implementation
Source: Author's analysis, 2025

Figure 2 presents the node connectivity map by sub-district before and after the BRT plan. The map on the left indicates that, prior to the BRT implementation, high node connectivity was concentrated in only a few areas, primarily in the west and southeastern parts of Surabaya. Large portions of the city remained in low to moderate level in connectivity zones. Therefore, the map on the right as after the BRT plan, there is notable expansion of high-level connectivity zones across a wider area, including northern and western sub-districts. Those sub-districts are Mulyorejo, Sukolilo, and Sambikerep. This reflects a more evenly distributed and inclusive public transport network, improving accessibility across multiple regions of the city and promoting more balanced urban mobility.

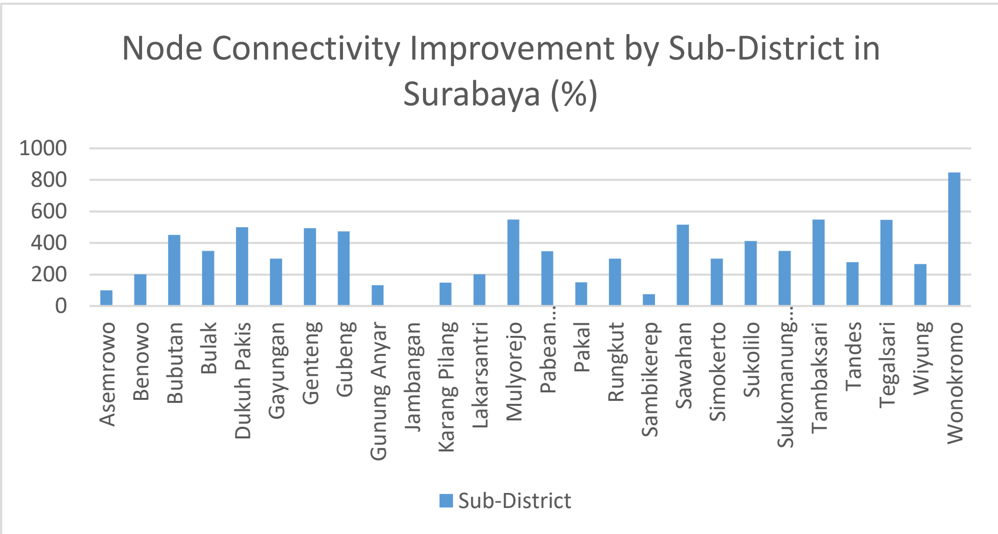


Figure 3. Node Connectivity Improvement by Sub-District in Surabaya
Source: Author's analysis, 2025

Figure 3 displays the percentage improvement in node connectivity across sub-districts in Surabaya following the implementation of the BRT plan. The chart shows that nearly all sub-districts experienced a substantial increase, with some areas-such as Wonokromo, Tegalsari, and Karang

Pilang-reaching improvements above 600%, indicating a massive improvement in public transport access. This widespread improvement demonstrates the BRT plan's effectiveness in addressing connectivity gaps at the local level. It particularly benefits previously underserved sub-districts, promoting a more inclusive and efficient urban mobility and network throughout the city.

- Line Connectivity

Line Connectivity refers to the level of connectivity of a route, especially the Wira Wiri Surabaya Feeder route. The level of route connectivity is obtained from the accumulation of the results of the node connectivity analysis with the number of nodes or stops on one Wira Wiri route.

Table 3. Line Connectivity Index Before and After BRT Implementation

Route		Before			After			Percentage
		Line Connectivity	Number of Passing Nodes	Connectivity Index Per Node	Line Connectivity	Number of Passing Nodes	Connectivity Index Per Node	
FD1	Terminal Benowo – Tunjungan	44.19	47	0.961	203	47	4.413	359%
FD2	Mayjen Sungkono – Balai Kota	107.66	56	1.957	743.99	56	13.527	591%
FD3	TIJ – Gunung Anyar	282.15	140	2.030	1287.43	140	9.262	356%
FD5	Mayjen Sungkono – Puspa Raya	254.33	52	4.987	713.4	52	13.988	180%
FD6	TIJ – Lakarsantri	147.64	108	1.380	669.98	108	6.261	353%
FD7	Term. Bratang – Stasiun Pasar Turi	133.19	71	1.903	764.9	71	10.927	474%
FD8	Term. Osowilangun – UNESA	159.11	26	6.364	511.3	26	20.452	221%
FD9	Term. Menanggal – Term. Manukan	149.21	64	2.368	644.56	64	10.231	332%
FD10	Term. Keputih – Bunguran	245.63	55	4.549	1411.38	55	26.137	474%
FD11	Term. Bratang - Bulak	191.94	32	6.192	1078.39	32	34.787	462%

Table 3 illustrates the significant improvements in line connectivity across various routes in Surabaya after the network is integrated into the BRT network. Prior to the BRT implementation, most routes had relatively low line connectivity index and modest connectivity index per node. For instance, route FD1 had a line connectivity score of only 44.19 and an index of 0.961 per node. After the BRT implementation, that same route experienced a sharp increase to a line connectivity score of 203 and an index of 4.413 per node, which is a 359% improvement. The most notable increase is seen in route FD2, where the connectivity index per node rises from 1.957 to 13.527, representing a 591% increase, indicating the strategic impact of the BRT system on high-demand corridors. Route FD10 and FD11 also demonstrated remarkable enhancements with an increase of 474% and 462%, respectively, showcasing how the BRT system has substantially boosted connectivity even in previously well-connected routes. Interestingly, while the number of passing nodes remained constant for each route, the massive rise in the overall line connectivity suggests a busy and more integrated route structure. These results confirm the effectiveness of the BRT plan in optimizing public transit infrastructure by significantly increasing access, integration, and efficiency across multiple key transport corridors in the city.

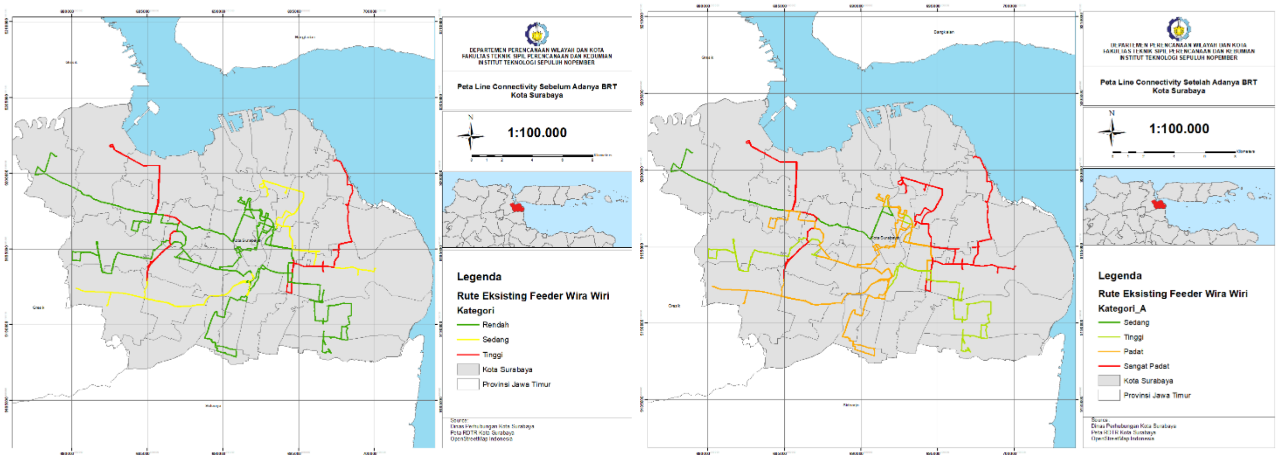


Figure 4. Line Connectivity Map Before and After BRT Plan
Source: Author's analysis, 2025

Figure 4 illustrates the changes in line connectivity before and after the implementation of the BRT plan in Surabaya. The map on the left, showing the pre-BRT condition, highlights limited connectivity in many areas, particularly in central and southern zones. After the BRT plan, line connectivity becomes significantly higher and more evenly distributed, especially in the city's central and eastern areas. This improvement suggests that the BRT system enhanced route integration and accessibility across a broader urban area, helping to reduce service gaps and improve transit efficiency citywide.

4. Conclusion

Although the BRT plan in Surabaya has not yet been implemented, simulation and connectivity analysis show that its integration with the Wira Wiri feeder system has strong potential to significantly improve the efficiency of the city's public transportation network. The projected increases in both node and line connectivity, some by over 500%, demonstrate that the BRT system could fill major service gaps, reduce travel time, and enhance access across diverse sub-districts. These findings suggest that the BRT plan, if realized, could support more inclusive mobility, reduce operational inefficiencies, and encourage a shift away from private vehicles.

The Surabaya City Government is encouraged to accelerate the implementation of the BRT plan, ensuring robust integration with the Wira Wiri feeder system. Emphasis should be placed on optimizing high-impact feeder routes, improving infrastructure at major transfer nodes, and expanding service coverage in areas with previously low connectivity. To further maximize the benefits, the city should also invest in real-time information systems, service frequency adjustments, and public outreach campaigns to increase ridership. Finally, the evaluation of value of time saved should be incorporated into fare policy and long-term investments planning, ensuring that BRT and feeder improvements lead to sustainable and inclusive urban transportation development.

Future research could further explore the specific characteristics of zones with low connectivity improvement to understand the underlying causes, whether due to existing demand profiles, mismatched service planning, or limitations in route integration. This analysis is essential to determine if current plans align with projected demand or if significant gaps remain in achieving equitable and effective multimodal integration across all areas of Surabaya. Such insights will be crucial for guiding more targeted and adaptive public transport development strategies in the future.

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