

Analysis of the Availability of Pedestrian Facilities for Mode Shift in Supporting the Merak-Banten Transit-Oriented Development (TOD) Area

Sarah Auliya Furjatullah¹, Muhammad Zudhy Irawan^{2*}, Agus Taufik Mulyono³

^{1,2,3}Department of Civil and Environmental Engineering, Gadjah Mada University, Indonesia

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ABSTRACT

High accessibility is a challenge for Cilegon City, an area with high transportation demands due to increasing migration rates. Increasing the high accessibility of Cilegon City can be focused on integrating transportation nodes in the Merak area, namely the Merak Integrated Terminal, Merak Harbor, and Merak Station, especially pedestrian accessibility as one of the indicators in the TOD area development plan in Merak-Banten. This research focuses on the walking interest of users of transportation nodes at modal shift facilities, knowing the level of interest and performance of capital switching facilities that can support a walking claim. The results of field observations show that several modal shift facilities need to meet the minimum service standards. Based on the results of the crosstab analysis and the chi-square test, it is known that social, economic, and demographic characteristics are related to the respondent's walking interest in capital transfer facilities that comply with minimum service standards. The minimum service standards consider security, safety, and comfort. Based on the results of the analysis using the importance-performance analysis (IPA) method, it is known that there are modal transfer facilities with a high level of importance but a low level of performance, namely the construction of a pedestrian bridge, the slope of the stairs and the direction facilities. Based on these conditions, optimizing the mode transfer facility per minimum service standards is necessary. This effort can be carried out in collaboration between stakeholders, such as the government and operators responsible for the three nodes.



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Corresponding Author:

Muhammad Zudhy Irawan,
Department of Civil and Environmental Engineering,
Gadjah Mada University,
Jl. Grafika Kampus No.2, Senolowo, Sinduadi, Mlati, Sleman, Yogyakarta, 55284, Indonesia.
Email: *zudhyirawan@ugm.ac.id

1. INTRODUCTION

Cilegon City is known as an industrial city that is geographically connected to the islands of Java and Sumatra. This strategic condition can attract people outside the area to migrate to Cilegon City. Migration that occurs continuously affects the community's need for transportation services as a

means of transportation to carry out daily mobility. The demand for transportation services may increase, including the increasingly intensive use of private vehicles. [1].

Judging from congestion, air pollution, and noise generated, using public transportation to meet travel needs is considered more efficient than using private vehicles [2]. There are three transportation nodes in Cilegon City, especially the Merak area, namely the Merak Integrated Terminal, Merak Port, and Merak Station, where the success of the public transportation system depends on the passengers and population served [3] the higher the number of passengers and population served, the transportation system it can be said to be successful. One of the efforts that can be made so that a trip can have high accessibility is to integrate the location of public transportation nodes in one area [4]. A mode's integration can be assessed by analyzing its physical form. Physical integration can use the parameters of transportation infrastructure connectivity with settlements and transportation infrastructure connectivity between one another [5]. In the case of transportation nodes, physical integration can be in the form of roads and bridges built continuously [6].

There is a development plan for the Transit Oriented Development (TOD) area in the Integrated Terminal area in Banten Province [7]. The basic principle of the TOD area is to build a place where people's mobility uses non-motorized vehicles such as walking. This plan can be implemented in the Merak Integrated Terminal area, bearing in mind that there is a transit principle in planning the TOD area at that location, namely facilitating connectivity between public transportation facilities. Pedestrian facilities are an essential element when planning urban design because they are a link between urban spaces, including links between transportation nodes [8]; however, it is common for facilities such as pedestrians at transportation nodes to have conditions that are not optimal.

Implementing non-motorized vehicles at nodes can occur when mode-switching activities occur; standards require a mode transfer facility to accommodate passengers who walk from one node to another. The primary services that need to be provided by the transportation node as a place for mode-switching activities include passenger access to the transportation network and switching between modes [9]. Pedestrians have several rights, such as the availability of facilities that support pedestrian activities and priority when crossing the road at crossings. If pedestrian facilities are unavailable, pedestrians can travel where they choose but pay attention to safety [10]. Development is also needed to improve services for users to provide maximum benefit, such as providing easy travel when going to and leaving modes [11] by utilizing digital technology. Development can be focused on supporting facilities to complement existing facilities [12], such as information services, payment facilities, and directions facilities.

2. METHODS

The research location is at the Merak Integrated Terminal transportation node, Merak Station and Merak Harbor as the locations used in the TOD Area development plan. Two types of data are needed to obtain information related to research so that research objectives can be achieved, namely primary and secondary data. The preliminary data used is the results of field surveys in the form of observations of the physical conditions of the modal transfer facilities at the three nodes to find out whether the existing conditions of pedestrian facilities comply with predetermined standards and are qualified towards the principles of the TOD area, and interviews with 200 respondents. Who has traveled to the three nodes to find out the characteristics of the travelers at the nodes, the willingness of the community to use modal transfer facilities if the available facilities are by the standards, and the level of importance and performance of the existing modal transfer facilities at the three nodes. The minimum service standard regulations used can be seen in Table 1.

Table 1. Regulation of Minimum Service Standards for Modal Transfer Facilities

Mode Transfer Facility	Type of Mode Transfer Facility	Regulation
Public passenger vehicle stopping facilities	Bus stop	Decree of the Director General of Land Transportation No. 271/HK.105/DRJD/96 concerning Technical Guidelines for Engineering of Public Passenger Vehicle Stops [13]
Pedestrian facilities	Sidewalks, road crossings	<ul style="list-style-type: none"> - Regulation of the Minister of Transportation of the Republic of Indonesia Number PM 98 of 2017 concerning Provision of Accessibility to Public Transportation Services for Service Users with Special Needs [14] - Minister of PUPR Regulation No. 03/PRT/M/2014 concerning Guidelines for Planning, Provision and Utilization of Pedestrian Network Infrastructure and Facilities in Urban Areas [15] - PUPR Minister Circular Letter No 02/SE/M/2018 concerning Technical Planning for Pedestrian Facilities [16]
Supporting facilities	Information service facilities, ticket and payment facilities, directions facilities	Information services are available at nodes and can be accessed using gadgets, cash, and cashless purchase and payment facilities are available, and directions are available to access modal transfer facilities

The secondary data used is the total population of Banten Province, minimum service standards for modal transfer facilities, and layout of modal transfer facilities.

2.1 Cross Tabulation

Cross tabulation is a statistical analysis to test a hypothesis and identify the relationship between one variable and another, presented in rows and columns. The input data using cross-tabulation is in the form of nominal or ordinal scale data, with the results showing the characteristics of the sample in the study from the effects of crossing these variables so that they have a descriptive relationship [17]. When performing crosstab analysis, it is necessary to know the closeness of the data or the level of association and the contents of the rows and columns to be cross-tabulated.

The cross-tabulation analysis performed functions to determine the relationship between the community's interest in walking when faced with conditions according to minimum service standards and social, economic, and demographic characteristics. If the significance value obtained is 0.05, then there is a relationship between interest in walking and social, economic, and demographic factors, whereas if the significance value obtained is more than 0.05, then there is no relationship between interest in walking and social, economic, demographics.

2.2 Importance Performance Analysis (IPA)

IPA analysis is a statistical analysis performed to determine how important an attribute on a particular object can be perceived in real terms by the user. The level of importance in the IPA analysis is assessed based on the four quadrants presented [18]; from the four quadrants, how many items are distributed in each quadrant [19]. The greater the difference, the higher the service improvement priority [20].

IPA analysis in this study determines respondents' level of interest and satisfaction as users when looking at the existing conditions of modal transfer facilities. Discussion on IPA analysis can focus

on indicators included in quadrant I. Quadrant I means that the variable is a top priority because the level of importance is high while the level of satisfaction is low, so it requires optimization.

3. RESULTS AND DISCUSSION

3.1. Analysis of the Relationship between Mode Transfer Facility and Interest in Walking

The analysis was conducted on modal transfer facilities found at the research location: sidewalks, zebra crossings, pedestrian bridges, and supporting facilities. Social, economic, and demographic characteristics are age, income, vehicles used, the purpose of travel, and travel distance. Based on the results of the crosstab analysis with the chi-square test it is known that there are variables with a significance value of less than 0.05, which means there is a relationship between the interest in walking at safe, safe and comfortable bus stops with social, economic, demographic characteristics.

3.1.1. Bus Stop

Social, economic, and demographic characteristics related to the interest in walking at the bus stop are age, income, and purpose of the trip. Age and purpose of travel are related to the interest in walking at safe and safe bus stop facilities. At the same time, income influences the interest in walking at safe, safe, and comfortable bus stop facilities. The variables of vehicles used and the distance traveled is entirely unrelated to the interest in walking at the bus stop. People with low incomes can walk to minimize travel costs incurred. In contrast, people with high incomes who live in urban areas have active walking activities because the facilities available are adequate [21]. At the three transportation nodes, which are the research locations, it is known that there are no bus stops as modal transfer facilities. This can be a consideration for stakeholders to provide safe, secure, and comfortable shelters because it affects the interest in walking. The chi-square test analysis results at bus stops can be seen in Table 2.

Table 2. Results of Chi Square Analysis of Interest in Walking at Bus Stops with Characteristics

Social, Economic, Demographic	Interest in walking		
	Secure	Safety	Comfort
Age	*0,033	*0,034	0,316
Income	*0,021	*0,000	*0,047
Commonly used vehicles	0,513	0,986	0,716
Travel purpose	*0,028	*0,009	0,451
Travel distance	0,434	0,335	0,171

Note: * show the significance of the related factors

3.1.2. Sidewalk

Based on the analysis conducted, it was found that income affects the interest in walking on safe sidewalk facilities. At the same time, travel distance is related to the interest in walking on safe and comfortable sidewalk facilities. Age, vehicle use, and trip purpose were utterly unrelated to the respondent's interest in walking on the sidewalk. Regarding a study conducted by [22], travel distance indeed is one of the most influential factors in the decision to walk, and people tend to walk at short distances, namely less than 2.5 km. The study also shows that a road network with high connectivity can increase the number of pedestrians during peak hours due to a shift from public transportation. The results of the chi-square test analysis on sidewalks can be seen in Table 3.

Table 3. Results of Chi Square Analysis of Interest in Walking at Side Walk with Characteristics

Sosial, Economic, Demographic	Interest in walking		
	Secure	Safety	Secure
Age	0,330	0,186	0,186
Income	0,085	0,120	*0,012
Commonly used vehicles	0,162	0,587	0,853
Travel purpose	0,291	0,649	0,231
Travel distance	0,327	0,092	*0,039

Note: * show the significance of the related factors

3.1.3. Zebra Cross

If seen from the analysis results, income affects respondents' walking interest in safe zebra crossing facilities. At the same time, the vehicles used affect respondents' walking interest in comfortable zebra crossing facilities. Age, purpose, and travel distance were utterly unrelated to the respondents' walking claim on the zebra crossing. When viewed from the vehicle variables commonly used daily, people tend to feel more comfortable when traveling by private vehicle when compared to walking because comfort can be handled without having to think about the condition of pedestrian facilities [23]. The results of the chi-square analysis on zebra crossing can be seen in Table 4.

Table 4. Results of Chi Square Analysis of Interest in Walking at Zebra Cross with Characteristics

Sosial, Economic, Demographic	Interest in walking		
	Secure	Safety	Secure
Age	0,400	0,316	0,200
Income	*0,042	0,082	0,239
Commonly used vehicles	0,255	0,260	*0,040
Travel purpose	0,228	0,451	0,848
Travel distance	0,685	0,804	0,859

Note: * show the significance of the related factors

3.1.4. People Crossing Bridge

Based on the analysis results, income is related to the respondent's walking interest in a safe and safe bridge facility. At the same time, the vehicle used is associated with the respondent's walking claim in a secure bridge facility. Age, purpose, and travel distance were unrelated to the respondents' interest in walking on the bridge. The results of this test align with the statement that people not only feel comfortable but also tend to feel safer when traveling by private vehicle when compared to walking, which can come in direct contact with other people [23], mainly if the trip is carried out at night. The results of the chi-square analysis on JPO can be seen in Table 5.

Table 5. Results of Chi Square Analysis of Interest in Walking at People Crossing Bridge with Characteristics

Sosial, Economic, Demographic	Interest in walking		
	Secure	Safety	Secure
Age	0,666	0,316	0,200
Income	*0,043	*0,025	0,161
Commonly used vehicles	*0,013	0,260	0,298
Travel purpose	0,684	0,451	0,848
Travel distance	0,413	0,576	0,592

Note: * show the significance of the related factors

3.1.5. Supporting Facilities

If seen from the analysis results, income and travel purposes are related to the interest in walking at nodes equipped with accessible payment facilities. Age, commonly used vehicles, and travel distances are utterly unrelated to the interest in walking at nodes equipped with supporting facilities..

The payment facility available at the node is an effort to make it easier for prospective passengers to travel. High-income people follow technological advances, so they will feel facilitated if payment facilities are provided via gadgets or cashless. For work travel purposes, using devices or cashless payment facilities is considered more effective [24]. The results of the chi-square analysis on node support facilities can be seen in Table 6.

Table 1. Results of Chi Square Analysis of Interest in Walking at Supporting Facilities with Characteristics

Sosial, Economic, Demographic	Interest in walking		
	Information Services	Payment Facilities	Directions Facilities
Age	0,531	0,170	0,625
Income	0,291	*0,003	0,338
Commonly used vehicles	0,241	0,986	0,212
Travel purpose	0,689	*0,020	0,840
Travel distance	0,621	0,804	0,333

Note: * show the significance of the related factors

3.2. Analysis of the Level of Interest and Satisfaction with Mod Transfer Facilities

3.2.1. Bus Stop

Based on the results of supervision carried out at the Merak Integrated Terminal, Merak Port, and Merak Station, there are no modal transfer facilities in the form of bus stops at these three nodes. Under these conditions, IPA analysis cannot be carried out.

3.2.2. Sidewalk

Based on the results of the analysis using the IPA method, there are no indicators that need to improve service quality (Quadrant I). Regarding the condition of the sidewalk that connects the Merak Integrated Terminal - Merak Port Regular Pier - Merak Station, it is known that it does not have guiding blocks and markings, and the lighting needs to be fully functioning. On the sidewalk that connects the Regular Port of Merak Pier with the Merak Integrated Terminal and vice versa, it is known that the available lighting is quite good. Still, there are no continuous signs and guiding blocks. On the sidewalk, the direct access to Merak Station, the lighting indicators at night are minimal, and guiding blocks, signs, and markings are unavailable on the sidewalk. This condition can be a concern for stakeholders to improve services on sidewalks, especially on lighting indicators, guiding blocks, and the provision of signs and markings. IPA analysis on sidewalks can be seen in Figure 1.

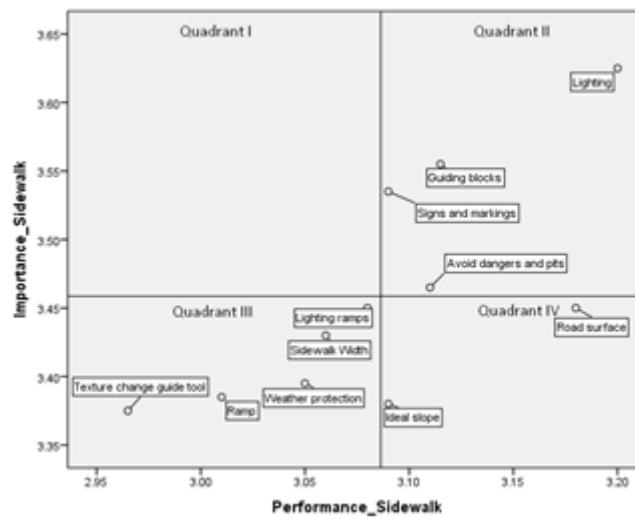


Figure 1. Sidewalk Importance Performance Analysis Results

3.2.3. Zebra Cross

From the results of this analysis, it is known that no indicators need to be improved on service quality (Quadrant I). At the Merak area transportation node, zebra crossing is available as a mode-switching facility from the Merak Integrated Terminal to the Merak Port Executive Pier and vice versa. Based on the survey results, the general lighting, visibility, and markings are by the SPM, but no road markings support pedestrian safety. This condition can be a concern for stakeholders to improve services at available zebra crossings, especially on the road marking indicators. The results of IPA analysis on zebra crossing can be seen in Figure 2.

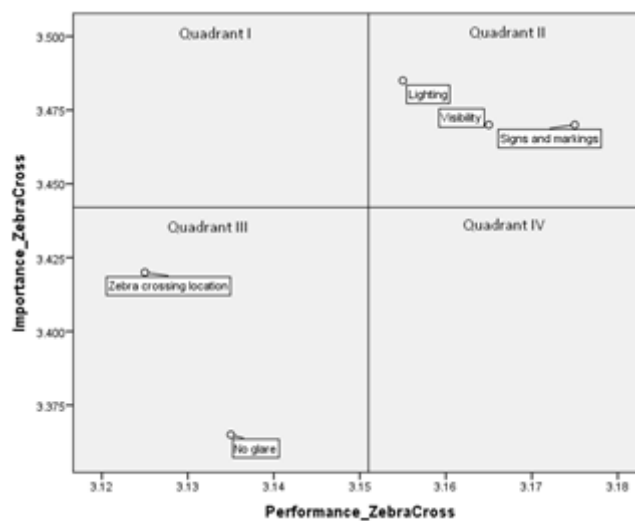


Figure 2. Zebra Cross Importance Performance Analysis Results

3.2.4. People Crossing Bridge

Based on the results of the IPA analysis, some indicators are in quadrant I as a facility with a high level of importance but a low level of respondent satisfaction, so it is necessary to improve services. In quadrant I, it is known that improving services in bridge construction and the slope of the bridge stairs is essential. Based on the results of a survey conducted, indicators of robust bridge construction and the slope of the stairs on the bridge connecting the Merak Integrated Terminal and the Merak Port Executive Wharf and vice versa, as well as the bridge connecting the Merak Port Regular Wharf

and Merak Station and vice versa have met the SPM. The results of the IPA analysis on the bridge can be seen in Figure 3.

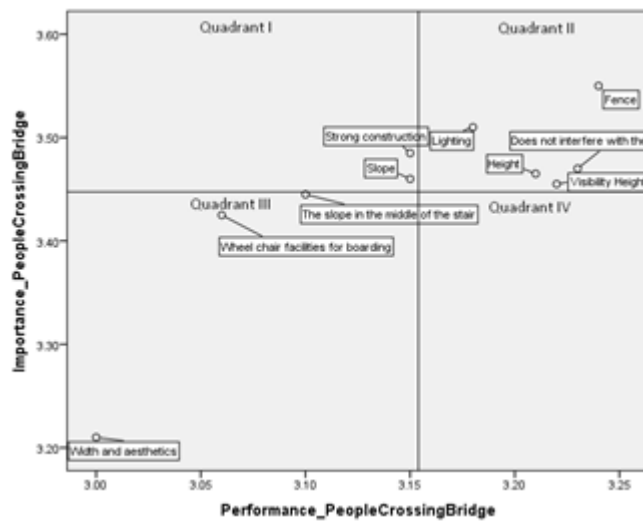


Figure 3. People Crossing Bridge Importance Performance Analysis Results

3.2.5. Supporting Facilities

Based on the results of the analysis, it is known that there are indicators that are in quadrant I, which means a high level of interest but a low level of respondent satisfaction. The arrow in quadrant I is directional facilities. The results of a survey conducted at all transportation nodes in the Merak area show that all of them already have directional facilities inside the node outside the node and directional facilities when changing modes, except at the station. Peacock. At Merak Station, directions outside the node have yet to be available. Seeing these conditions, improving service performance at supporting facilities is necessary, especially the provision of directional facilities outside the node at Merak Station. The results of the IPA analysis at supporting facilities can be seen in Figure 4.

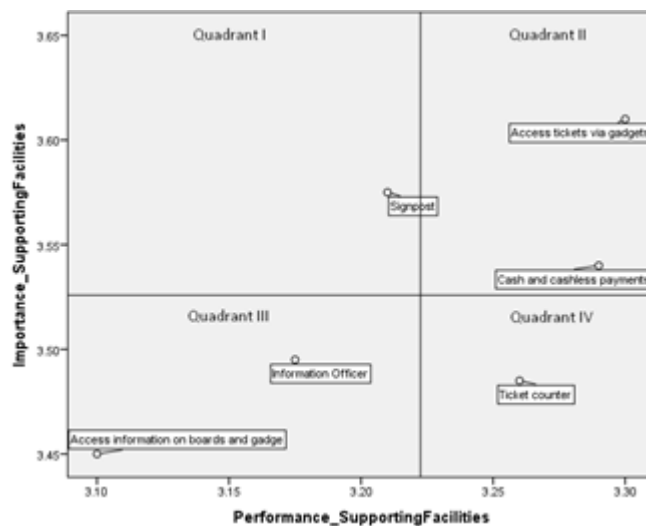


Figure 4. Supporting Facilities Importance Performance Analysis Results.

4. CONCLUSION

Based on a survey conducted at the existing modal shift facilities at the Merak Integrated Terminal, Merak Port, and Merak Station, it is known that there are modal shift facilities whose conditions need to be by the Minimum Service Standards. This discrepancy can be affected because the assessment indicators are unavailable at the transfer facility or are available. Still, the conditions need to be by the Minimum Service Standards. When viewed from the ha crosstab testing with the chi-square test to see the relationship between the interest in walking when faced with facilities that comply with the Minimum Service Standards and social, economic, and demographic characteristics, it is known that there are social, economic, demographic characteristics related to the interest in walking in each modal transfer facility. Meanwhile, the importance performance analysis (IPA) results show that not all indicators of modal transfer facilities need to be improved in service because not all assessment indicators fall into quadrant I. The facilities that need to be enhanced by the standard of service for people crossing bridges are the construction and the slope of the stairs. In contrast, it is necessary to improve services at directional facilities outside the node for supporting facilities. Suppose it is related based on the results of a survey conducted on the standard assessment of modal transfer facilities. In that case, modal transfer facilities are by the standards, but the respondents are not satisfied with their performance, namely robust construction on people crossing bridges.

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