



Pedestrian User Satisfaction Analysis

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Abstract: the role played by pedestrian is noticeably becoming more important as part of transportation infrastructure. The number of pedestrian user increases especially in the big cities' business district. Therefore, this study was constructed to study the pedestrian users' satisfaction to the side walk facility. The study was conducted in the city of Surabaya, the Indonesian second biggest city. The study aimed the pedestrian users in some of the busiest districts in central of Surabaya. On the other hand, there have been many policies made by the Surabaya government to improve the pedestrian performance especially the side walk facility, such as making the pedestrian to be more colorful and attractive. The study used qualitative method and Importance Performance Analysis (IPA). There are twenty variables used as addressed objects to measure pedestrian users' satisfaction level, which are civil service police, greening, parking space, bus stop, parking meter, intercept area, main hole, public sitting, bollard, pedestrian floor motif, disability facility, hand wash facility, portable toilet, direction map, street vendors, drinking water facility, pedestrian decoration and trash bin. The result shows that there are only two variables performs above their importance level. The average of importance level is 4,021 while the average of performance level is 3,743. There is -0,278 gaps which indicates that the pedestrian performance is under the pedestrian users expectation. Moreover, based on the IPA, there is no one of the variables place in the first quadrant (high leverage, attributes to improve), while there are seven variables place in the second quadrant (attributes to maintain). There are eight variables performing as in the third quadrant (low priority) and lastly there are five variables perform as in the fourth quadrant (low leverage, attributes to de-emphasize).

Keywords: Pedestrian, Performance, IPA, Surabaya

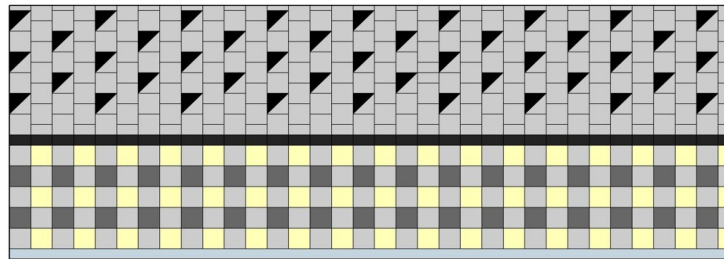
INTRODUCTION

Surabaya is the second largest metropolis in Indonesia, where its existence is in the center of the East Java provincial government and at the same time the center of industry, trade and services. The movement of residents from surrounding cities to find a living in Surabaya is very large; this can be seen from the traffic jams that occur every day along roads in Surabaya.

Walking is one of the most basic forms of human movement, so it is necessary to get proper facilities so that there is a guarantee of safety and comfort for pedestrians in their activities. One of the pedestrian facilities that must be fulfilled is a pedestrian path (sidewalk).

In several areas of trade and service centers as well as government centers in the city of Surabaya, pedestrian path designs (sidewalks) have been applied using several design themes or also known as thematic pedestrian paths. Some of the examples are as at Jalan Karet with the theme of the old city, at Jalan Tunjungan with the theme of Kota Tua and Jalan dr.soetomo with the theme of 3D shapes. More details example regarding the existing designs in the city of Surabaya can be seen in the Figure 1.

motif keramik Jl. Tunjungan (Praban - Tanjung Anom)



keramik uk. 30 x 30 cm

Figure1. The ceramic pattern at Jalan Tunjungan

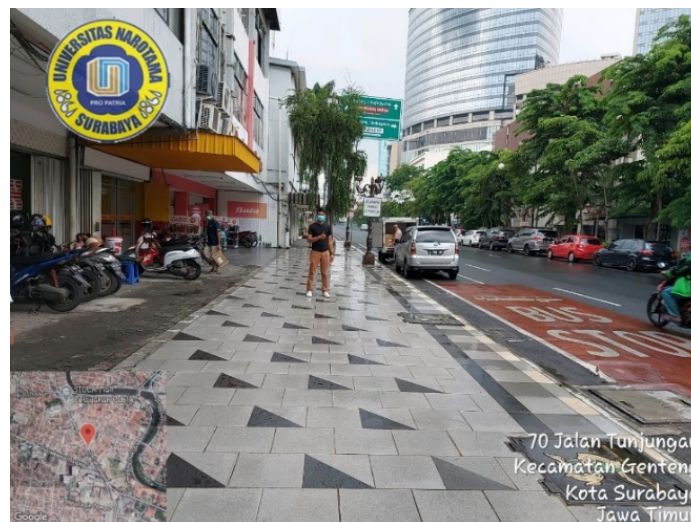


Figure 2. The implementation of ceramic pattern at Jalan Tunjungan

Moreover, until July 2018, the construction of pedestrians and canals reached 5,463.6 meters with an average pedestrian width of 3 meters with various lengths found in 16 points in the city of Surabaya. Pedestrian development with a thematic pedestrian path design adds to the beauty of the sidewalk, but it is not yet known the level of efficiency, safety and pedestrian comfort with the construction of these sidewalks. For this reason, it is necessary to know and analyze the level of pedestrian users' satisfaction to the pedestrian paths (sidewalks) in the city of Surabaya.

Based on the previewed problems, the research constructed basic questions as the research's objectives, which are 1. How is the pedestrian users' satisfaction level to the side walk performance? 2. What is the result of the pedestrian Importance Performance Analysis (IPA), and 3. What are the recommendations and suggestions that can be given based on the analysis results?

On the other hand, the research limits the objectives to; 1. The object of this research is pedestrian facilities (sidewalks) located at several points in the central business district (CBD) in Surabaya. 2. The survey was conducted at several points in the central business district (CBD) in Surabaya by distributing questionnaires to sidewalk users about their socio-economic characteristics, travel characteristics, and direct recording for user satisfaction data collection. 3. Respondents who are surveyed are respondents who used pedestrian facilities (sidewalks) at the time of the survey. 4. The method used to determine satisfaction and interests based on the perceptions of service users is the IPA method and also qualitative statistical analysis.



LITERATURE REVIEW

A. Pedestrian

Pedestrian is a term in transportation that is used to describe people who walk on a pedestrian path either on the side of a road, sidewalk, and a special lane for pedestrians or crossing the road. To protect pedestrians from the traffic, pedestrians are required to walk on the certain part of the road and crossing only at the provided crossing root. Moreover, pedestrian facilities must be planned based on the following conditions:

1. Pedestrians must reach the destination as close as possible, safe from other traffic and smooth.
2. The continuity of pedestrian facilities, which connect between areas.
3. If a pedestrian lane cuts off traffic flows, a traffic regulation must be carried out, either with control lights or with crossing markings, or crossing places. Pedestrian paths that cut through traffic in the form of crossings (zebra cross), road markings with traffic lights (pelican cross), pedestrian bridges and tunnels.
4. Pedestrian facilities must be made on roads in urban areas or at places where the volume of pedestrians meets the terms or conditions for the construction of these facilities.
5. Pedestrian paths should be located in a way with other traffic lanes, so that pedestrian safety is guaranteed.
6. Equipped with signs or other road attachments, so that pedestrians are free to walk, especially for pedestrians with physical disabilities.
7. Planning for pedestrian paths can be parallel or cut across existing traffic lanes.
8. Pedestrian paths should be made in such a way that if it rains the surface is not slippery, there is no puddle and it is advisable to provide shade trees.
9. To maintain pedestrian safety and discretion, road curbs must be installed so that pedestrian facilities are higher than the road surface.

On the other hands, in consideration of places where it should be constructed, the pedestrian facilities must to consider the following criteria;

1. Pedestrian facilities must be installed in locations where the installation of these facilities provides maximum benefits, both in terms of safety, comfort or smooth travel for the user.
2. The level of pedestrian density, or the number of conflicts with vehicles and the number of accidents should be used as a basic factor in the selection of adequate pedestrian facilities.
3. At locations where there are public facilities and infrastructure.
4. Pedestrian facilities can be placed along the road or in an area that will result in pedestrian growth and is usually followed by an increase in traffic flow and fulfilling the terms or conditions for the construction of the facility. These places include:
 - Areas of industry
 - Shopping centers
 - Office centers
 - School
 - Bus terminal
 - Housing
 - Entertainment center

B. Pedestrian Path (Sidewalk)

According to Bina Marga, sidewalks are pedestrian paths that are located in the benefit area of the road, given a surface layer, given an elevation higher than the surface of the



pavement and generally parallel to traffic. Sidewalks can be installed with the following conditions:

1. Sidewalks should be placed on the outer side of the road shoulder or the outer side of the traffic lane.
2. Sidewalks should be parallel to the road, however sidewalks may not be parallel to the road if topographical conditions or local conditions are not possible.
3. The sidewalk should be placed on the inside of the open drainage channel or on top of the drainage channel which has been closed with compliant concrete slabs.
4. Sidewalks at bus stops should be placed side by side with the bus lane. Sidewalks can be placed in front of or behind the bus stop.

C. Pedestrian Path (Sidewalk) Equipment

1. Waiting area;
 - i. it should be installed in wide traffic lanes, where road crossers find it difficult to cross safely.
 - ii. The minimum width of the waiting area is 3 meters.
 - iii. It to be painted with reflective paint
2. Signs;
 - i. Signs are placed in such a way that they are clearly visible and do not obstruct pedestrians.
 - ii. Signs are placed on the left according to the direction of traffic, outside a certain distance from the outer edge of the pedestrian path.
 - iii. Signs must be fixed and sturdy and clearly visible at night.
3. Road markings;
 - i. Only placed on the pedestrian path that cuts the road in the form of Zebra Cross and Pelikan Cross.
 - ii. The road markings are made in such a way that they are clearly visible to the road users concerned.
 - iii. Installation of the markings must be fixed and sturdy and not cause slippery on the road surface and clearly visible at night.
4. Traffic light;
 - i. Traffic lights are placed on the pedestrian path that intersects the road.
 - ii. Installation of traffic lights must be fixed and sturdy.
 - iii. Placement of traffic lights in such a way that they are clearly visible to traffic vehicles.
 - iv. Traffic lights should be bright enough so that they can be seen clearly during the day and at night.
5. Complementary buildings; the complementary building must be strong enough in accordance with its function to provide safety and comfort for pedestrians.

D. Pedestrian Path Technical Standards

Pedestrian paths technical standards are as follows:

1. The width and alignment of the pedestrian lane must be free; at least when two pedestrians cross paths, one of them does not have to go down the vehicle traffic lane.
2. The minimum width of the walkway is 1.5 meters.
3. Maximum pedestrian flow is 50 pedestrians / minute.
4. To be able to provide optimal service to pedestrians, the path must be paved, and if there is a difference in height from the surrounding area, it must be given a barrier (can be a curb or a barrier).
5. Pavement can be made from concrete blocks, concrete, asphalt pavement, or stucco.



6. The surface must be flat and have a transverse slope of 2 - 4% to prevent stagnant water. the longitudinal slope is adjusted for the slope of the longitudinal road and it is recommended that the maximum slope is 10%.
7. The width of the pedestrian path should be increased, if traffic signs, mailboxes, shade trees or other public facilities are placed on the lane.
8. The minimum width of the pedestrian path is taken from the width required for the movement of 2 pedestrians hand in hand or 2 pedestrians passing by without the occurrence of an intersection. The minimum absolute width of the pedestrian path is determined as $2 \times 75 \text{ cm} + \text{the distance between the adjacent buildings, namely } (2 \times 15 \text{ cm}) = 1.80 \text{ m}$.

The minimum width is used the following formula:

$$LT = L_p + L_h$$

Where; LT = the total width of the pedestrian path

L_p = The width of the pedestrian path required according to the desired comfort level.

L_h = additional width due to obstruction of the existing buildings.

As for several types of pedestrians that are currently used in existing trade and service areas, including:

1. Enclosed mall is a pedestrian-only area that is covered (roofed) to protect pedestrians from cold / snow or hot weather. The concept resembles a sub urban shopping mall that can operate every season and is usually applied in cold climates and 4 seasons. This mall requires a fairly expensive fee.
2. Full mall, transit mall or transit way, is made by closing the road that was previously used for vehicles and then turning it into a special pedestrian area by adding sidewalks, road furniture, trees, fountains, and so on. This type of pedestrian mall usually has a certain character and helps in building the image of the city center. The pedestrian mall transit and transit way are types of malls that are built by diverting vehicle traffic from a road section and only public transportation is allowed through the road. The sidewalks for pedestrians were widened, on-street parking was prohibited, and the roads were designed to create a unique impression in the downtown area.
3. Semi mall is a type of mall made by reducing parking on the road body and traffic flow through the road. Semi pedestrian malls are usually on the main road around the city center. In places for walking there are green open spaces, seats, street lighting and other aesthetic elements. This mall is often applied to big cities that have difficulty covering the total area of the city center from vehicles.

E. Satisfaction factors

In the general heading of transportation, there are three main categories where users' satisfaction addresses to, which are;

1. Performance of elements that affect service users, such as: speed, operation, trustworthiness and security.
2. Quality of service, including qualitative elements of service, such as: comfort, user behavior, beauty and cleanliness.
3. The price that must be paid by service users to get services.

Meanwhile, according to Rohmawati, T & Natalia, 20218, for pedestrian users themselves, there are several factors that affect user satisfaction on pedestrian paths (sidewalks), including:

1. Physical conditions
2. Security
3. Hard scape
4. Softs cape
5. Convenience
6. Aesthetic
7. Social space
8. Environmental quality, and
9. Path facilities

F. Importance Performance Analysis (IPA)

The Importance Performance Analysis (IPA) method was first introduced with the aim of measuring the relationship between consumer perceptions and product / service quality improvement priorities, which is also known as quadrant analysis (Brandt, DR 2000) and (Latu, TM, & Everett, AM 2000). Conceptually, Performance Analysis (IPA) is a multi-attribute model. This technique identifies the strengths and weaknesses of market offerings using two criteria, namely the relative importance of attributes and customer satisfaction.

The application of the science technique begins with the identification of the attributes that are relevant to the observed choice situation. A list of attributes can be developed by referring to the literature, conducting interviews, and using managerial assessments.

On the other hand, a set of attributes attached to goods or services is evaluated based on how important each product is to consumers and how the service or goods are perceived by consumers. This evaluation is usually fulfilled by conducting a survey of a sample of consumers. After determining the appropriate attributes, consumers were asked two questions. One is an attribute that stands out and the second is the performance of the companies that use these attributes.

By using mean, median or ranking measures, the scores of importance and performance attributes are collected and classified into high or low categories; then by pairing the two sets of rankings, each attribute is assigned to one of the four quadrants of performance importance. The mean performance and importance scores are used as coordinates to plot individual attributes on the two-dimensional matrix shown in Figure 3. below:

Gridline : Overall Mean for Importance	QUADRANT I Concentrate Here	QUADRANT II Keep up the good work
	High Importance Low Satisfaction	High Importance High Satisfaction
	QUADRANT III Low Priority	QUADRANT IV Possible Overkill
	Low Importance Low Satisfaction	Low Importance High Satisfaction

Figure 3. Importance Performance Analysis Quadrant

The following is an explanation for each quadrant (Brandt, D.R. 2000):

1. First Quadrant, Increase Performance (high importance & low performance) The factors located in this quadrant are considered very important factors by consumers but the current condition is not satisfactory so that the management is obliged to allocate adequate resources to improve the performance of these various factors.
2. Second Quadrant, Maintain Performance (high importance & high performance) The factors located in this quadrant are considered as supporting factors for consumer

satisfaction so that management is obliged to ensure that the performance of the institutions it manages can continue to maintain the achievements that have been achieved.

3. Third Quadrant, Low Priority (low importance & low performance) The factors located in this quadrant have a low level of satisfaction and are considered not too important to consumers, so that management does not need to prioritize or pay too much attention to these factors.
4. The Fourth Quadrant, Excessive (low importance & high performance) The factors located in this quadrant are considered not very important so that management needs to allocate resources related to these factors to other factors that have a higher priority for handling which still needs improvement, such as the fourth quadrant.

METODOLOGY

A. Research Stages

The Figure 4 explains the research stages in a research flow chart.

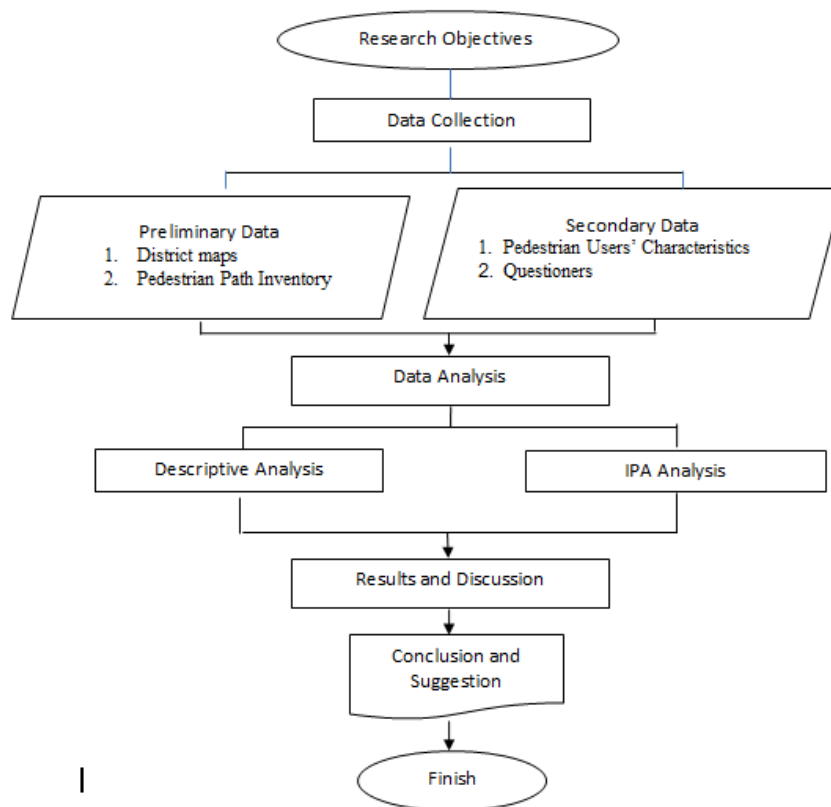


Figure 4. Research Flow Chart

B. Research Locations

The location of data collection was carried out in the central business district (CBD) and government public services areas in Surabaya.

C. Preliminary Research

The preliminary research was carried out before the actual research with the aim of knowing the conditions and characteristics of the respondents in this study who were users who carried out walking activities in several CBD areas in the city of Surabaya, as well as to test the reliability of the questionnaire in answering the research objectives. Through a preliminary



survey, secondary data obtained from sources outside the research itself and secondary data will also be used to determine the variables used in the study, and become the basis for the preparation of the questionnaire.

D. Variables of Research

The preliminary research identifies 20 pedestrian objects which become research variables as mentioned in table 1.

Table 1. Variables of the research

Code	Variable	Code	Variable
X1	civil service police	X11	bollard
X2	plants	X12	pedestrian floor motif
X3	Bike/motor parking	X13	disability facility
X4	Lighting	X14	hand wash facility
X5	parking space (cars)	X15	portable toilet
X6	bus stop	X16	direction map
X7	parking meter	X17	street vendors
X8	intercept area	X18	drinking water facility
X9	main hole	X19	pedestrian decoration
X10	public seating	X20	trash bin

E. Data collection

Sampling in this study is a combination of accidental sampling techniques and purposive / judgment sampling. The accidental sampling method is a sampling technique based on chance, in which anyone who happens to meet the researcher can be used as a respondent; if it is deemed that the person who happened to be met is suitable as a data source. Meanwhile, purposive / judgment sampling is a sampling technique chosen based on the research objectives, namely the sample data based on certain characteristics related to the research.

F. Data Analysis

The research analyses the collected data in two stages. Firstly, the collected data was plotted in a spider plot based on the average scores for the importance level and performance level of each variable. By using this method we can clearly analyze the gaps between the level of importance with the level of performance for each variable.

Then, the data analysis was continued by using Importance Performance Analysis (IPA), which gave further information regarding each variable performance and recommendations for improvement.

RESULTS AND DISCUSSION

A. Spider Plot Analysis

Table 2. The Variables' Average Score of Importance and Performance Level

No.	Variables	Importance	Performance	Gaps (I-P)
1	civil service police	4,442	4,183	-0,258
2	Plants	4,188	3,933	-0,254
3	Bike/motor parking	3,933	3,292	-0,642
4	Lighting	4,150	3,758	-0,392
5	parking space (cars)	3,933	3,717	-0,217
6	bus stop	3,958	3,717	-0,242



7	parking meter	4,000	3,483	-0,517
8	intercept area	3,992	3,442	-0,550
9	main hole	3,792	2,992	-0,800
10	public seating	3,992	3,992	0,000
11	bollard	4,050	3,792	-0,258
12	pedestrian floor motif	4,167	3,842	-0,325
13	disability facility	3,967	3,842	-0,125
14	hand wash facility	3,933	3,733	-0,200
15	portable toilet	3,967	3,933	-0,033
16	direction map	4,042	3,917	-0,125
17	street vendors	4,000	3,967	-0,033
18	drinking water facility	3,975	3,479	-0,496
19	pedestrian decoration	3,892	3,933	0,042
20	trash bin	4,050	3,917	-0,133
Total		4,021	3,743	-0,278

There are twenty indicators used to measure the level of satisfaction of pedestrian behavior on pedestrian paths in Surabaya. Only two service indicators have performance beyond the level of importance, while the other 18 indicators have performance levels below the level of importance.

Overall, the average value of the importance level was 4.021, while the performance value was 3.743. There is still a gap of -0.278 which indicates that the service performance in the Surabaya city pedestrian has not met the expectations of service users. An overview of the level of importance and service performance conditions in the Surabaya city pedestrian can be seen in the Spiderplot below. The indicator that has the biggest gap is the 9th indicator, namely "Main Hole" with a value of -0.800.

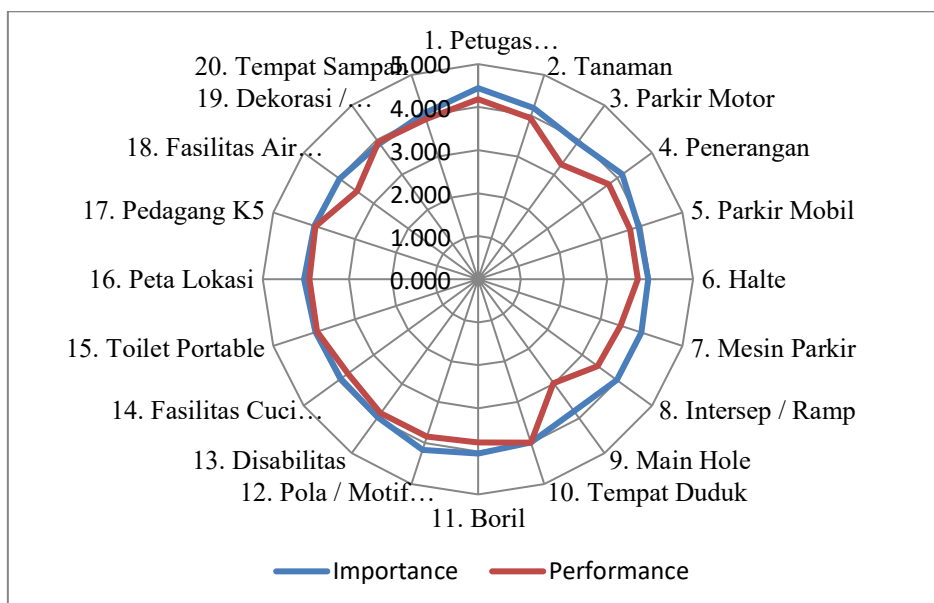


Figure 5. Spider Plot for the Importance and Performance Level of Pedestrian Variables

B. Importance Performance Analysis (IPA)

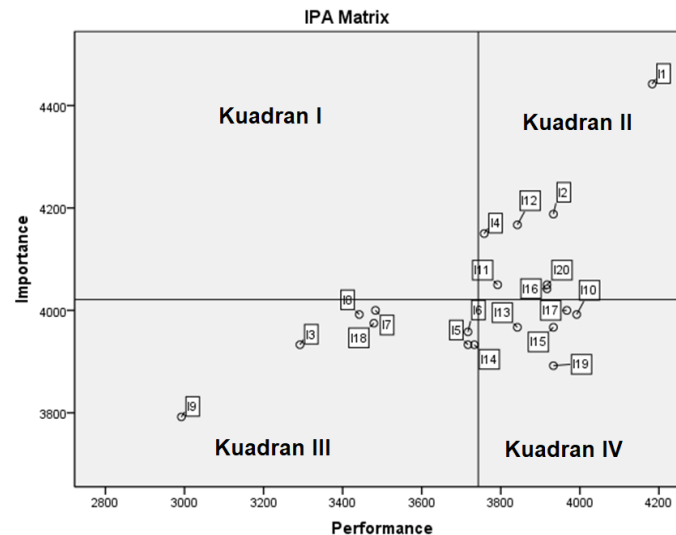


Figure 6. IPA Quadrant Diagram for Importance and Performance Analysis

There are four quadrants to categorize all research variables. It can be seen that quadrant I is empty, none of the indicators are included in quadrant I, which means that none of the indicators are included in the high leverage category, attributes to improve, showing the variables that are priority improvements, are expected by users, and the level of importance / high satisfaction, but low quality.

The variables that fall into quadrant II are x1 (Control Officer), x2 (Plants), x4 (Lighting), x11 (Bollard), x12 (Floor Pattern / Motive), x16 (Location Map), and x20 (Trash Bin). Indicators that are included in quadrant II are included in the category of attributes to maintain, showing the variables that should be maintained, because in terms of high quality, the level of importance / satisfaction by users is also considered high. Facility advantage is determined by the variables in this quadrant.

The variables included in quadrant III are x3 (Motorcycle Parking), x5 (Car Parking), x6 (Bus Stop), x7 (Parking Meter), x8 (Intercept / Ramp), x9 (Main Hole), x14 (Hand Washing Facilities) and x18 (Drinking Water Facilities). Variables that are included in quadrant III are included in the low priority category, showing variables that are less priority, in terms of low quality, likewise the level of interest or user satisfaction is also considered low, so that it can be ignored.

The variables included in quadrant IV are x10 (Public Seating), x13 (Disabilities), x15 (Portable Toilets), x17 (Street Vendors), and x19 (Decorations / Ornaments). Variables that are included in quadrant IV are included in the low leverage category, attributes to de-emphasize, showing variables that can be said to be excessive, because quality is considered high, but less expected or the level of importance / satisfaction is low. In some cases, the performance of these variables can be reduced for efficiency.



CONCLUSION

Based on the results of the analysis, it is concluded that:

1. From the analysis that has been done, we can conclude that the user satisfaction level of pedestrians in the city of Surabaya shows that there are 7 variables that are considered to be performing well. The performance of these variables is above the average value. The seven variables are trash bins, plants, lighting, bollards, floor patterns / motifs, location maps and public service police.
2. From the results of the IPA analysis, we can conclude that none of the variables are in quadrant I (Main Priority), which means there are no variables that need special attention. Whereas for Quadrant III (Low Priority), there are 8 variables, where this quadrant has the highest number of variables. The variables are motorbike parking, car park, bus stop, parking machine/meter, intercept (ramp), drinking water facilities, hand washing facilities and main hole. For quadrant IV (Excessive), there are 5 variables, namely public seating, disabilities, portable toilets, street vendors and decorations / ornaments. And the last is the variable that is included in quadrant II (Maintain Performance), namely trash bins, plants, lighting, bollards, floor pattern patterns, location maps and public service police.
3. Recommendations that can be given based on the analysis of this research are that the variables in quadrant II need to be maintained, while the variables in quadrant III need to be improved / enhanced.

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