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EVALUATING SERVICE QUALITY AND PASSENGER SATISFACTION OF FEEDER BUSES IN URBAN PUBLIC TRANSPORTATION

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Abstract

Semarang faces congestion issues in land transportation, prompting the city government to introduce feeder buses connecting lower-demand areas to major transit hubs. The preliminary survey found that the number of passengers increased steadily. However, the increase in this number was accompanied by an increase in the number of passengers' complaints. Thus, this study attempts to measure passenger satisfaction using the Consumer Satisfaction Index (CSI) and evaluates operational performance with the Importance and Performance Analysis (IPA) method. The literature review identified 14 aspects to measure passenger satisfaction, covering 28 attributes. Aspects needing improvement in quadrant I of the IPA analysis include vehicle condition, driver competency, and promptness of service providers in addressing complaints. Recommendations for improvement include adjusting departure intervals during peak and off-peak hours, implementing driver evaluation programs, conducting regular fleet inspections, and fostering customer engagement through forums.

Keywords: *Customer Satisfaction; Public Transportation; Feeder Bus; Service Quality; IPA*

1. Introduction

Transportation has made diverse contributions to the lives of individuals in both urban and rural places. Efficient transportation infrastructure can enhance the economic sector's productivity (Liu & Su, 2021); (Kutty et al., 2020). Public transit is considered one of the most vital transportation networks. An adequate transportation system is needed to support the positive outcome of urbanization (Pradhan et al., 2021).

The urbanization rate in Indonesia has increased steadily over time. As of 2010, urbanization has reached 33.64% (Hassan & Pitoyo, 2018). The high number of Indonesian citizens who own private vehicles indicates that public transport has not yet earned significant popularity among the public. Furthermore, the public transport system in Indonesia is still not integrated (Nuha, 2022). Accessibility, comfort, service attitude, safety, and cost can influence the public's perspective on public transportation (Göransson & Andersson, 2023). The discomfort experienced while using public transport contributes to Indonesian individuals' low interest in using public transport (Simangunsong et al., 2023).

Semarang is a city that experiences congestion problems, especially regarding land transportation. The Semarang City Government provides Bus Rapid Transit (BRT) to establish a transportation system that is both comfortable and secure. However, BRT is unable to reach remote areas. In response to this issue, the Semarang City Government is incorporating paratransit into the existing transportation systems. BRT's feeder service functions as a paratransit system to link areas that lack access to primary modes of transportation, such as trains or buses.

Based on data provided by the Trans Semarang Public Service Technical Implementation Unit (BLU UPTD), the initial launch of the BRT's Feeder service in April 2022 recorded a monthly passenger of 2,000 passengers. By March 2023, this number had increased to 4,700 passengers per month. The mean passenger growth rate is approximately 6%, with the most significant surge occurring from December 2022 to January 2023 at a rate of 31%. BRT's Feeder has created various channels for passengers to submit complaints, including its complaint website, call center, and Trans Semarang application. In 2022, the number of complaints received is projected to increase from 5 complaints to 94 in 2021.

Therefore, it is necessary to measure the quality of feeder services and assess consumer satisfaction. This involves evaluating the performance of service providers based on specific attributes as determined by consumer assessments. This research will provide fresh

insight for the BLU UPTD Trans Semarang, enabling them to deliver high-quality services to the passengers of BRT's feeder. Recently, user satisfaction has become an increasingly important area in transportation services. Moreover, transportation services, especially public transport satisfaction, have been studied extensively. Urban areas require residents to use the available public transportation system to promote and achieve sustainable development (Soza-Parra et al., 2019).

Based on the phenomena described above, the quality of feeder services must be assessed. A combination of CSI and IPA methods is commonly used for quantifying consumer satisfaction (Lubis et al., 2020; Utami et al., 2022; Yuliyanto et al., 2022). Agustina & Sahfitr (2022) attempt to measure customer satisfaction with online transportation using CSI and IPA methods. Suhanto et al. (2023) also used CSI and IPA to evaluate the level of satisfaction with services provided at the airport. Rhamdani & Widyastuti (2023) combined CSI & IPA to analyze the quality services of public transportation.

The CSI method can determine the overall level of consumer satisfaction regarding performance attributes (Utami et al., 2022). The IPA method helps identify the most crucial attributes for customers and the areas that require improvement by categorizing attributes into the four quadrants of the IPA diagram. The diagram guides the allocation of managerial actions based on each attribute's performance and importance scores (Aghajanzadeh et al., 2022; Esmailpour et al., 2020).

Despite the growing body of literature assessing public transportation services in Indonesia, significant research gaps remain—particularly regarding paratransit systems functioning as feeders to primary transport modes. Past studies have primarily focused on mass public transport such as bus rapid trans (Adibah & Manullang, 2020; Ulkhaq et al., 2019), commuter lines (Aisyah et al., 2019), and city bus (Rhamdani & Widyastuti, 2023). Limited research has specifically examined feeder systems, which serve a critical role in last-mile connectivity.

The feeder bus is a distinct service type with operational characteristics and user expectations that differ from conventional mass transport (Cai et al., 2024). Yet, it remains underexplored in the context of user satisfaction and service quality evaluation. Different types of public transportation have different attributes that need to be considered (Guirao et al., 2016). This research provides new insight into the assessment of the service quality of paratransit transportation, specifically feeder buses.

Furthermore, few researchers have investigated user satisfaction during the early implementation phase of a paratransit service, as in the case of the Semarang BRT feeder service launched in 2022. Early-phase analysis is crucial, as it captures the formative perceptions of passengers, which can influence long-term public acceptance and use. Most existing studies (Agustina & Sahfitri, 2022; Rhamdani & Widyastuti, 2023) focus on well-established systems, leaving a knowledge gap regarding how newly introduced services are perceived and what specific attributes influence satisfaction during the service adoption stage.

Lastly, while CSI and IPA have been widely used to assess service quality, limited studies specifically combine these tools to analyze feeder-based paratransit services. This research aims to identify and assess service quality through a set of attributes considered essential in increasing feeder service quality using CSI and IPA methods. This research fills a methodological and contextual gap in the existing literature and provides practical insights for transport authorities.

2. Research Methods

The feeder service was launched in December 2019 and serves two routes: feeder 1, which covers the Ngaliyan-Kp Gondoriyo (Route A) and Ngaliyan-Modukoro Raya (Route B), and feeder 2, which covers the Terboyo-SMA N 15 and Terboyo-Rusunawa Kudu routes. This research will specifically examine Feeder 1. The number of passengers using Feeder 1 shows a consistent pattern of growth and variation every month. The data used in the research was gathered via the distribution of questionnaires to passengers. The questionnaire used a Likert scale with 5 categories to assess consumer satisfaction. The formulation of assessment attributes was done through literature studies considering the minimum service standards set by Semarang city government regulations.

2.1 Customer Satisfaction Index (CSI)

The methodology of measuring customer satisfaction using the Customer Satisfaction Indexes (CSI) method includes several different steps, which are as follows (Anurrasyid & Sumitra, 2019; Wiguna et al., 2023):

1. Determine the Mean Importance Score (MIS) for each attribute
2. Determine the Mean Satisfaction Score (MSS) for each attribute
3. Calculate Weighting Factor (WF)
$$WF_i = \frac{MIS_i}{\sum MIS}$$
4. Calculate Weighting Score (WS)
$$WS_i = MSS_i \times WF_i$$
5. Calculate the Satisfaction Index (CSI) for a questionnaire consisting of 5 scales.
$$CSI = \frac{\sum_{i=1}^{n} WS}{5} \times 100\%$$

2.2 Importance & Performance Analysis (IPA)

IPA quantifies service satisfaction by calculating the difference between performance and importance. In the IPA method, the attribute will be mapped into four quadrants of a Cartesian diagram, where each quadrant shows the level of performance (x-axis) and the level of importance (y-axis). **Figure 1** explains the four quadrants.

3. Result And Discussion

Out of 100 respondents, 81 are female. Also, 60 respondents have a high school education, 80 are between 15 and 24 years old, and 89 are students.

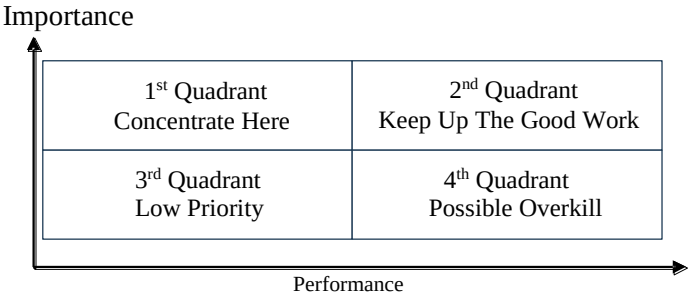

Figure 1. IPA Matrix (Martilla & James, 1977)

Table 1. Service Quality Attributes Based on the SERVQUAL Model

Servqual Dimensions	Definition	Adapted Aspect in Public Transport
Tangibles	Physical facilities, equipment, and appearance of personnel	Vehicle's Comfort, Vehicle's Cleanliness, Environment
Reliability	Ability to perform the promised service dependably and accurately	Transportation Route, Service, Price, Waiting & Travel Time, Availability, Reliability
Responsiveness	Willingness to help customers and provide prompt service	Customer Service (Staff Assistance & Engagement)
Assurance	Knowledge and courtesy of employees and their ability to inspire trust and confidence	Safety (Vehicle Condition, Driver Competence, & Crime Prevention)
Empathy	Caring, individualized attention the firm provides its customers	Congestion (Crowd Levels & Personal Comfort), Information Accessibility

Forty-four respondents use the feeder service 4-6 times a week, and 78 belong to the Students/ Children/ Seniors/ Veterans category.

The indicators used in this study were developed through a literature review and transportation service standards shown in **Table 1**. A total of 14 aspects with 28 specific indicators were identified to measure user satisfaction. Each aspect was derived from previous research. Each attribute was translated into a questionnaire item that captures the public perception of the feeder service. These questionnaire items were designed to reflect users' evaluation of service performance and attribute importance.

The indicators reflect the SERVQUAL model's evolution by adapting its five core dimensions to transportation-specific contexts and operationalizing them into measurable variables suitable for passenger perception analysis and performance evaluation. Developed by Parasuraman et al. (1988) the SERVQUAL model identifies five core dimensions of service quality. These dimensions serve as a conceptual framework for assessing service quality across different industries.

In public transportation (e.g., BRT, feeder systems), researchers have re-contextualized these dimensions to reflect the nature of transit services, where physical infrastructure, punctuality, comfort, safety, and information access play critical roles. Primary data was collected through a questionnaire survey targeting passengers of the BRT feeder service. Respondents rated their perceptions on a Likert scale based on the provided service attributes. Before starting data processing, the data obtained from compiling respondents' questionnaires underwent a validity and reliability test. A validity test determines whether a questionnaire contains issues that render it irrelevant. The study included a sample size of 100 respondents, with a confidence level of 95% and a r value of 0.195. According to the test results, all attributes in the valid category passed validity test values because the r value for each attribute exceeded 0.195 (Denis, 2021).

The reliability test is a test that measures the level of reliability of a measuring instrument. Measurement's results are considered when multiple repetitions of the measurement within a group yield consistently similar results and there is no variation in the aspect being measured. The reliability test conducted in this study used the Cronbach alpha value. The questionnaire passed the reliability test with a value of $\alpha \geq 0.6$. Typically, values above 0.6 are considered acceptable for most research purposes (Nguyen et al., 2020; Slater, 1995).

The CSI is calculated by dividing the Weighted Score (WS) by the maximum scale used. The following is the CSI value:

$$CSI = \frac{4{,}029}{5} \times 100\% = 80{,}5\%$$

According to the satisfaction index, the Customer Satisfaction Index (CSI) value of 80% falls within the 66% - 80% range, indicating that the feeders' passengers are generally categorized as "satisfied" (Lubis et al., 2020). In this research, IPA is utilized to compare feeder passengers' evaluations of the attribute importance (Y) with the attribute performance (X). **Table 2** is a recapitulation of the X and Y values for each attribute.

According to **Table 3**, the attribute with the smallest gap between the level of service performance

Table 2. Recapitulation of Importance and Performance Level

Aspect	No	Attribute	Reference	X	Y	*Gap*
Transportation Route	1	The feeder route passes the passenger's intended destinations.	Eboli & Mazzulla (2009)	4.37	4.61	-0.24
	2	The distance passengers travel between feeder stations is reasonable.	Eboli & Mazzulla (2009), Esmailpour et al (2020)	4.19	4.51	-0.32
	3	The number of feeder stations is adequate.	Eboli & Mazzulla (2009), Rhamdani & Widyastuti (2023)	4.14	4.31	-0.17
Service	4	The frequency of feeder trips meets passengers' needs.	Purba et al. (2015), Rhamdani & Widyastuti (2023)	4.25	4.58	-0.33
	5	Feeder operational hours are good.	Purba et al. (2015), Esmailpour et al (2020)	4.03	4.47	-0.44
Price	6	Ticket rates are affordable.	Gao et al. (2016), Esmailpour et al (2020), Aisyah et al. (2019)	4.74	4.8	-0.06
Waiting & Travel Time	7	The waiting time at the feeder station is reasonable.	Gao et al (2016), Esmailpour et al (2020)	3.24	4.23	-0.99
	8	The time required to reach the destination is reasonable.	Gao et al (2016), Esmailpour et al (2020)	4.12	4.44	-0.32
Availability	9	Feeder vehicle availability.	Poliakova (2010), Rhamdani & Widyastuti (2023)	4.17	4.6	-0.43
Reliability	10	The feeder is arriving on time.	Purba et al. (2015), Ulkhaq et al. (2019), Rhamdani & Widyastuti (2023)	3.92	4.43	-0.51
Comfort	11	The passenger seat is comfortable.	Gao et al. (2016)	4.03	4.58	-0.55
	12	Passengers are comfortable with the temperature in the feeder.	Gao et al. (2016), Esmailpour et al (2020)	3.41	4.5	-1.09
	13	The noise level inside the feeder is low.	Gao et al. (2016)	3.45	4.31	-0.86
	14	There is an appropriate room at the station to wait for the feeder.	Gao et al. (2016), Rhamdani & Widyastuti (2023)	4.15	4.6	-0.45
Congestion	15	Crowding in the feeder.	Gao et al. (2016), Soza-Parra et al. (2019)	3.55	4.49	-0.94
Cleanliness	16	The seats, windows, and floors inside are clean.	Gao et al. (2016), Esmailpour et al (2020), Ulkhaq et al. (2019)	4.24	4.58	-0.34
	17	The exterior of the feeder is clean.	Gao et al. (2016), Esmailpour et al (2020)	4.08	4.38	-0.3
Information	18	Schedules and route maps are available inside the feeder.	Gao et al. (2016), Esmailpour et al (2020), Adibah & Manullang (2020)	3.52	4.4	-0.88
	19	schedules and route maps are available at the station.	Gao et al. (2016), Esmailpour et al (2020), Adibah & Manullang (2020), Rhamdani & Widyastuti (2023)	3.48	4.38	-0.9
	20	Passengers can access information (routes, operating hours) and track feeder locations through a website or application.	Gao et al. (2016), Ulkhaq et al. (2019)	4.39	4.71	-0.32
Safety	21	The feeder is in good condition.	Eboli & Mazzulla (2009), Ulkhaq et al. (2019)	4.01	5.14	-1.13
	22	The driver drives safely.	Eboli & Mazzulla (2009)	3.52	4.7	-1.18
	23	Feeders are safe from possible crimes.	Eboli & Mazzulla (2009), Esmailpour et al (2020), Ulkhaq et al. (2019)	4.54	4.8	-0.26
	24	The stations are safe from possible crimes.	Eboli & Mazzulla (2009), Esmailpour et al (2020)	4.41	4.7	-0.29
	25	Officers respond to passengers and provide needed information.	Purba et al. (2015), Ulkhaq et al. (2019), Adibah & Manullang (2020)	4.41	4.72	-0.31
Customer Service	26	Passengers can easily submit complaints or suggestions.	Purba et al. (2015)	4.32	4.6	-0.28

Aspect	No	Attribute	Reference	X	Y	*Gap*
	27	The service provider acts quickly when handling complaints.	Purba et al. (2015)	3.99	4.57	-0.58
Environment	28	The feeder vehicle is environmentally friendly.	(Eboli & Mazzulla, 2009)	3.93	4.43	-0.5

Table 3. Suggested Improvements

Attribute	Suggested Improvements
7, 10	Evaluate adjustments in departure intervals for each fleet during peak and non-peak hours to maintain load factor values that meet the required standards. Based on the performance analysis of Feeder 1, it is evident that the load factor of Feeder 1 does not meet the current standards. The load factor is only 50%, whereas the ideal range is between 70% and 100%.
22	Launch the Best Trans Semarang Driver competition chosen by the passengers.
	Anonymous evaluation or assessment of feeder's drivers.
21, 12, 13, 15, 28	Periodically check the condition of the feeder fleet.
27	Hold regular meetings/customer forums to discuss unresolved complaints.

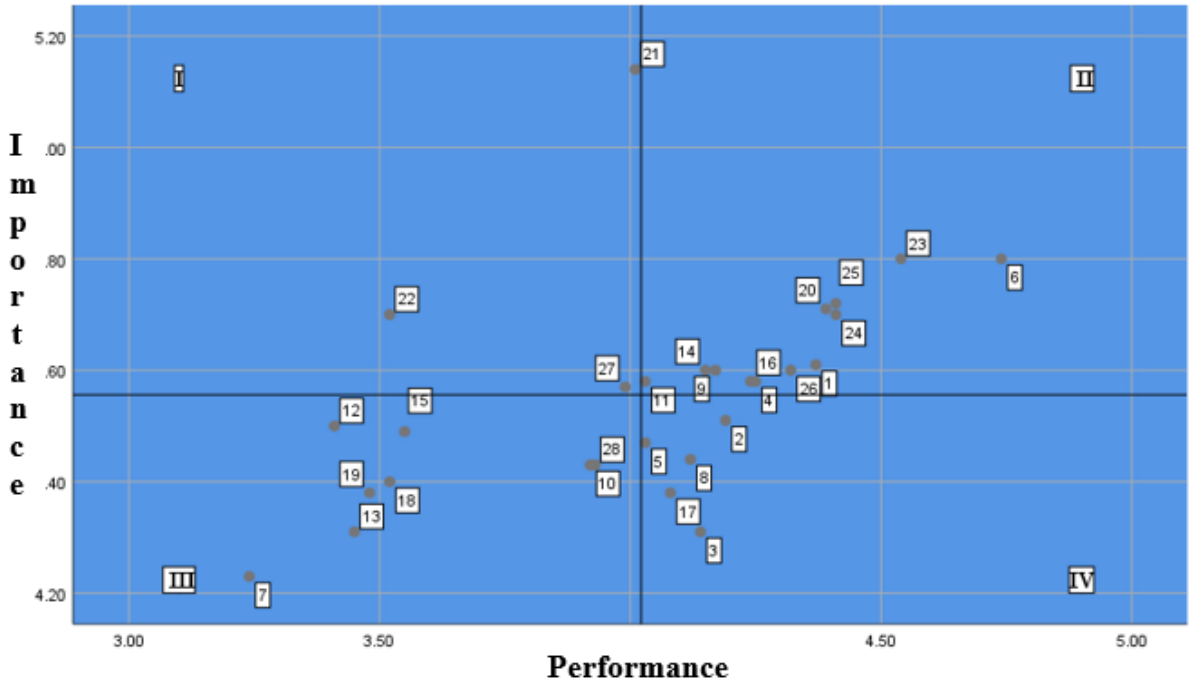

Figure 2. IPA Matrix

and the importance is attribute number 6, which refers to feeder ticket rates. Additionally, attribute number 23, which refers to the feeder's security level from criminal acts, shows a small gap. Attribute 22, the driver's driving ability, shows the most significant gap. The relationship perceived by consumers or customers between importance and performance is determined by the IPA matrix, which is divided into four quadrants defined by two perpendicular lines (*X* and *Y*). Graphing the mean values of X and Y on a Cartesian diagram shows the attributes' positions in the four quadrants, as depicted in **Figure 2**.

According to **Figure 2**, feeder managers should prioritize the attributes in quadrant 1. These attributes are essential to consumers but currently have low performance. Therefore, improvements are necessary. In quadrant 1, there are three attributes: (21) the condition of the feeder, (22) the driver's driving ability, and (27) the speed of the management in handling complaints. Apart from that, 8 attributes were obtained in quadrant 3, which means that the performance of these attributes is still lacking. These include attributes no: (7) waiting time for the feeder's arrival, (10) punctuality of the feeder, (12) temperature inside the feeder, (13) noise level inside the feeder, (15) crowding in the feeder, (19) the availability of a route map at the bus stop, (18) the availability of a route map in the fleet, and (28) utilization of environmentally friendly vehicles by the feeder. The eight attributes in quadrant 3 exhibit performance values below 50%, requiring improvement.

Recommendations for improvement can be derived from previous research on improvement solutions that align with the attributes in quadrants I and III. Afterward, the suggested improvements were chosen by three respondents in managerial positions, including the coordinator from the planning & control,

communications & information, and financial planning & accounting division.

This selection begins by determining the criteria for selection, assigning weights to these criteria, and scoring improvement suggestions using a 5-point Likert scale. The determining criteria are implementation with a weight of 45% and cost of implementation with a weight of 55% (Kiani Mavi et al., 2018). **Table 2** below is a list of recommendations for improvements based on the scoring by the management.

In a study by Saleem et al. (2023) on the quality of service provided by Bus Rapid Transit (BRT) in Pakistan, specific attributes, such as those related to environmental impacts, safety, and security, were also identified as areas requiring improvement. Saleem et al. (2023) address this issue by proposing in-vehicle monitoring system solutions, such as short-range circuits, closed-circuit television (CCTV), driver training on road safety, and GPS tracking to monitor vehicle speed and location.

4. Conclusion

The service quality of Feeder 1 has met passenger expectations, as indicated by the CSI value of 80.5%, which falls within the satisfied category. Even though the CSI result is categorized as "satisfied," several attributes still need to be improved based on the IPA matrix. The performance measurement results obtained using the IPA method indicate that three attributes are currently classified in quadrants 1, while eight are classified in quadrant 3. The recommendations primarily emphasize attributes in the first quarter.

This research is expected to serve as a benchmark for further research. This research can only accommodate a total of 28 attributes. Future research is anticipated to include additional attributes to enrich the research on evaluating service quality in public transportation services. This research should be considered in decision-making to provide optimal service for passengers.

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