Design of Mass Rapid Transit (MRT) Service Quality Through Analysis of Factor Affecting Passenger Behavior Intention Using PLS-SEM and QFD

Amalia Hasanah Nur Ahlina, Dendi P Ishak
Industrial Engineering Department, Faculty of Engineering
Universitas Indonesia
Depok, Jawa Barat, Indonesia
amalia.hasanah@ui.ac.id, dendi@ie.ui.ac.id

Abstract

Jakarta's massive economic growth has led to rapid urbanization. The urbanization and population growth, incommensurate with the infrastructure development, has caused transportation problems. This has triggered the government to establish sustainable transportation policies by adopting mass public transportation as a tool to attract people to use mass public transportation and reducing private vehicle users. Several modes of mass public transportations have been introduced by Jakarta government such as bus and train services, but the number of public transport users is still low. One of the causes of the small number of public transport users in Greater Jakarta is the low quality of transportation services compared to other modes. Therefore, the government introduces Mass Rapid Transit System (MRT) as a new mode of public transportation, the first underground rail system in Indonesia. Considered as a new public transportation mode, the provider needs to evaluate the quality service offered to persuade people to use it and to retain them. This study aims to assess the importance dimension of service quality and customer satisfaction on MRT passengers' behavior intention using partial least square structural equation models (PLS-SEM). This paper will explore the impact of several factors on passenger behavior intention towards public transport services. A comprehensive investigation of the factors regarding the relationship between Mass Rapid Transit (MRT) service quality and corporate image on customer satisfaction and behavior intention of transportation public user is a contribution that will be made through this research. We introduce the development of PLS-SEM analysis into an important performance matrix as the basis for formulating a service quality strategy by mass rapid transit public transport operators through the House of Quality method.

Keywords
Service Quality, Satisfaction, Behavior Intention, PLS-SEM, Quality Function Development.

1. Introduction
Jakarta's massive economic growth has led to rapid urbanization. The population of Jakarta in 2021 is 10.9 million and it is estimated that more than 16 million people in 2039 Transporation Agency of DKI Jakarta, 2021). The urbanization and population growth , which are not commensurate with the infrastructure development, has caused transportation problems. Indonesian government is committed to develop urban trains as mass public transportation. Public transportation has advantages in terms of energy-saving, environmentally friendly, and has a large capacity volume. So that the priority of developing public transportation is an inevitable need to reduce traffic congestion and improve people's living and public service standards by the government (Ni et al. 2020). Through the Jakarta-Bogor-Depok-Bekasi (Jabodetabek) Transportation Master Plan, the government has set a target that the people mobilization of using urban public transportation must reach 60% of the total mode share. One of the strategic steps taken is the development of a rail-based urban transportation system (Presidential Regulation of the Republic of Indonesia No. 55 of 2018). The establishment of an urban railway system is an effective solution in meeting the mobility pressures of urban communities. The introduction of a city railway system that is connects with other existing public transport networks is expected to have a positive effect on traffic congestion.

The previous studies show that people do not choose public transportation as a mode of travel because the quality of transportation services is still low (Paulley et al., 2006; Chowdhury and Ceder, 2016; Ibrahim et al. 2020). Private vehicles are attractive because they are more flexible, convenient, private, and faster (Hussain, 2020; Redman et al.,

2013). Public transport agencies must understand user needs to retain existing users and acquire new users. One way that public transport can achieve higher competitiveness than private vehicles is to improve the quality of public transport services (de Oña et al., 2020). With various aspects of the quality of public services, the public transport agency can identify performance that needs to be improved and gain new users. Thus, the success of a public transport service system depends on the number of passengers that can be attracted and retained (Shen et al., 2016). In the case of urban rail and other mass transportation, decision makers must listen to passengers' opinions to create an effective system and thereby encourage the use of public transportation (Yilmaz et al., 2021). To understand user needs, measuring customer satisfaction is an important thing to do, customer satisfaction will result in satisfaction values from various aspects of the service used by business managers in determining and prioritizing things that need to be improved (Le et al., 2020). The design of strategic steps is needed to assess the current level of passenger satisfaction and to identify management strategies to increase passenger satisfaction according to needs and be used to promote public transport services (Shen et al. 2016). However, when the customer is not satisfied with the service provided, there are two possible reactions, the customer may stop buying the service and switch to another competing provider or he can file a complaint with the provider (Oliver, 2010). Therefore, customer complaints are an important factor that must be considered and handled in providing business services. Most of the public transport agencies only focus on measuring the value of customer satisfaction without further investigating the factors that can impact and drive user behavior. As stated in several previous studies, customer satisfaction can affect loyalty in the form of the possibility to continue to use the service and the willingness to recommend it to others and engage in public transport activities (Vicente et al. 2020). Efforts to develop and maintain passenger loyalty are a successful strategy to support an increase in the number of passengers because loyal passengers will continue to use public transportation services without looking for or switching to other alternatives and tend to recommend these services to potential new users (Webb, 2010).Today's dynamic business environment encourages a new competitive concept, where organizations compete globally and comprehensively on various aspects of the products and services they provide, such as price, quality, to service satisfaction.

Basically, customer satisfaction and dissatisfaction with a product or service will affect subsequent customer behavior. From existing studies, there are many factors that can influence customer satisfaction and its impact on the intentions of public transport users. However, the lack of comprehensive model testing regarding the value and relationship of service quality dimensions, product or service image, and perceived value that can affect customer satisfaction and its impact on user behavioral intentions in the form of loyalty, filing complaints, is a contribution that will be given by this research. This study uses the PLS-SEM structural equation model to answer these problems with the aim of getting a better understanding of the relationship between variable dimensions in understanding consumer voice and behavior. Another contribution that will be generated is the development of PLS-SEM analysis into the analysis of the importance-performance matrix as the basis for formulating a service quality strategy that needs to be developed by the MRT provider through the House of Quality method.

1.1 Objectives

Based on the background that already state in the introduction, it is necessary to identify service needs that are suitable for public transport users. A comprehensive investigation of the factors regarding the relationship between MRT service quality and corporate image on customer satisfaction and its impact on behavioral intentions is a contribution that will be made through this research. Another contribution is the development of PLS-SEM analysis into the importance performance matrix as the basis for formulating a service quality strategy by the organizers of Mass Rapid Transit public transportation through the House of Quality method. Therefore, this study tries to answer the following questions:

1. What are the service quality attributes needed by public transport users?
2. How are the service quality, company image, perceived value, customer satisfaction, switching barriers, customer complaints, and loyalty variables related to one another?
3. What is the appropriate service design strategy to meet the needs of public transport service users?

2. Literature Review

Initially proposed a satisfaction theory called customer satisfaction, later Fornell summarized the Customer Index (CSI) and proposed the American customer satisfaction model (ACSI) (Fornell et al., 1996). The ACSI model measures the causality between customer satisfaction (customer expectations, perceived service quality, and perceived value) and consequences (customer complaints and customer loyalty). In addition, research shows that CSI can be used to predict firm profitability and market value (Anderson et al., 1994, 1997; Eklof et al., 1999).

Currently based on the ACSI model, many countries in the world such as Germany, South Korea, China, and other European countries have established a CSI model that is adapted to their respective contextual situations (Shen et al., 2016). To date, many studies have been conducted globally to measure the impact of customer satisfaction on complaints and loyalty (Malle and Yehualawork, 2017). Satisfaction-Loyalty Theory was expanded to explore causes of customer's loyalty to a particular service and has been extensively applied and adapted across a wide range of subjects (Jen et al., 2011). In the basic satisfaction-loyalty theory, perceived service quality and satisfaction are important to consider. Both are significantly contributed to loyalty development, while satisfaction is an important factor partially or completely mediating the impact of service quality on loyalty (Fu et al., 2016). Service quality is defined as "the customer's overall impression of the relative inferiority and superiority of the organization and its service" (Bitner and Hubbert, 1994). As a multidimensional (Parasuraman et al., 1985) and hierarchical (Jen et al., 2011) construct, PT services should be comprehensively measured to account for their intangible, inseparable, and heterogeneous properties (de Oña and de Oña, 2014; Parasuraman et al., 1991; Fu et al., 2016). The conceptual model of SERVQUAL was originally discovered by Parasuraman et al. in 1988 and has been developed over time. In addition to service quality and satisfaction variables, based on research conducted by Ni et al (2020) which resulted that corporate image can directly promote perceived quality and perceived value by customers. Besides that, a study conducted by Jen et al., (2010) consider the switching barriers factors to understand more deeply about user behavior intentions beyond service quality and customer satisfaction factors. The factors used in assessing the effect of the switching barrier dimensions are switching costs and the attractiveness of alternatives.

In the field of transportation, the number of studies on complaints and loyalty is still limited due to the complex measurement of both types of behavioral intentions (Shen et al., 2016). Various theories and methodologies have been applied in satisfaction research, including process hierarchy, fuzzy mathematics, and factor analysis. Methods such as Delphi, analytic hierarchical process (AHP) and fuzzy clustering methods focus on the use of subjective methods to determine the weight of variables in making assessments. At the same time, studies that focus on analyzing the relationship between satisfaction, or service quality, and other attribute differences are becoming increasingly popular using Structural Equation Modeling (SEM) or path analysis models (Shen et al., 2016). Several studies have used SEM in analyzing causality relationships between variables (Fu et al., 2018; Irtema et al., 2018; Putri et al., 2018). In estimating the parameters of the SEM model, the traditional method used is the linear structural relationship (LISREL) which assumes that all observations are independent and that the manifest variables obey a multivariate normal distribution, but this is not usually the case in the case of passenger's satisfaction (Lin, 2005). An alternative method that can be used is Partial Least Squares (PLS), which weakens the assumption of a normal distribution and can obtain latent variable scores that are explicitly estimated in the parameter estimation process, therefore PLS is more suitable for satisfaction research (Shen et al., 2016).

Importance Performance Matrix Analysis (IPMA) is useful in extending the finding basic PLS-SEM using latent variable scores (Fornell et al., 1996; Hock et al., 2010; Gronholdt et al., 2000; slack et al., 1994; Ahmad et al., 2014). For a specific endogenous construct representing a key target construct in the analysis, IPMA contrast the structural model total effect (importance) and the average values of the latent variable scores to highlight the significant areas for the improvement (Hair et al., 2013). This analysis has become crucial to identify the critical factors that determine satisfaction and loyalty. A basic PLS-SEM analysis identifies the relative importance of constructs in the structural model by extracting the estimation of the direct, indirect, and total relationship. The IPMA extends these PLS-SEM results with another dimension, which includes the actual importance and performance of each construct. When executing PLS-SEM, requires identifying a target construct first. To complete an IPMA of a particular construct, the total effects and the performance values are needed. The importance of latent constructs for an endogenous target construct is analyzed by means of an importance-performance matrix analysis which emerges from these variables total effect (Slack et al., 1994; Ahmad et al., 2014). In PLS-SEM, the total effect is derived from a PLS path model estimation. This analysis will be for formulating a service quality strategy by mass rapid transit public transport operators through the Quality Function Development (QFD) method with House of Quality (HoQ). QFD is a structured product planning and development method for ascertaining customer requirements and evaluating the ability of a proposed product or service to meet customer requirements (Cohen, 1995). The Quality Function Deployment methodology is a 4-phase process that encompasses activities throughout the product or services development cycle. The development of a series matrices called "House of Quality". A series of matrices are utilized at each phase to translate the Voice of the Customer to design requirements. The four phases of QFD are product planning, product development, process development, and process quality control. However, in this study, the HoQ process is only limited to phase 1, product planning.

3. Conceptual Model

The research model is a description of the relationship between the variables used in this study. The proposed conceptual model is an exploratory model based on various related previous model as depicted in figure 1. The model is a development of the standard model of service quality-satisfaction-behavioral intention which has been adapted for public transportation services, especially Mass Rapid Transit. The effects of many factors including service quality, perceived value, corporate image, and satisfaction, on passenger loyalty to public transport, and its relationship is studied comprehensively.

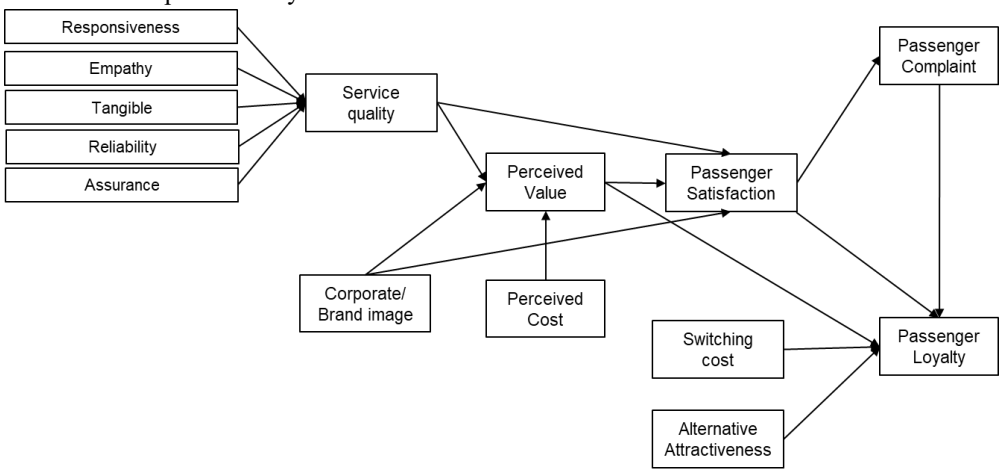

Figure 1. Proposed Research Model

4. Methods

The main purpose of this study was to use PLS-SEM, IPMA, and QFD to establish service strategies planning for MRT. The initial methods that used in this research is PLS-SEM analysis. SEM gives the researchers an ability to identify the attributes and relationship among several variables forming user satisfaction and loyalty by studying the interrelationship structure as expressed in a series of equations. In contrast to other multivariate techniques, SEM studies more than one relationship at a time. Thus, it is a method that can be used to test a set of hypotheses that consider all possible information (Hair et al., 2010). The SEM is consisting of two components, a structural model that illustrates the strengths and the direction of the relationships of the latent variables, and a measurement model that evaluates the unobserved latent variables and treats them as linear functions of observed variables. The second step is used IPMA to calculate the weighting of the importance of each service dimension by the path coefficient between the perceived service quality of SEM and the performance of each service dimension. Lastly, this study developed the service design strategy using QFD method. Voice of customer is taken from the results of PLS- SEM and IPMA analysis as the basis for designing a service quality strategy with the House of Quality (HoQ) in phase 1 by conducting interviews. The research procedures are shown in figure 2.

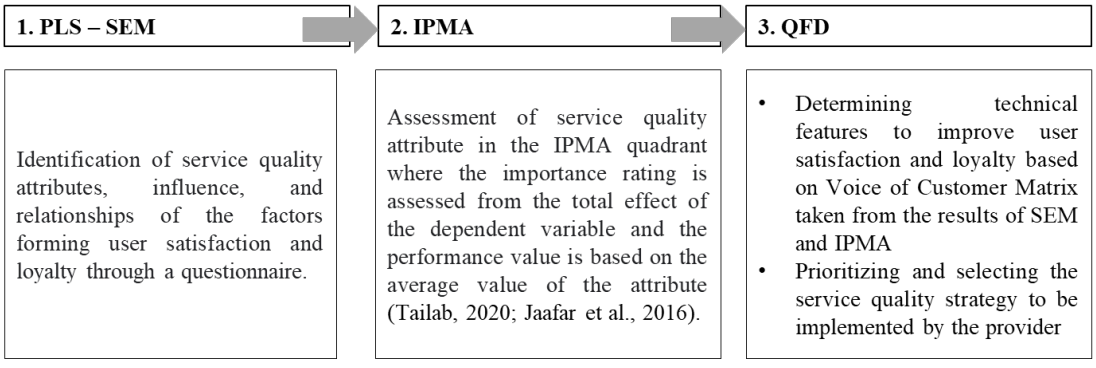

Figure 2. Research Procedure

5. Data Collection

All data requirements to support the analysis of this research consists of primary and secondary data. Primary data is data obtained directly from research subjects through the instruments used. While secondary data is data that has been available or collected to support the analysis. The primary data were collected through a customer survey among MRT Jakarta Passenger in 2022. A questionnaire was designed to investigate the opinion of passengers regarding public transport operator, and it was used to reveal the actual service. Before the questionnaires were formally distributed, a pilot study was conducted prior to the actual data collection as the only method of verifying the usefulness of the questionnaire. The questionnaire consists of two sections, section 1 contained six profiling questions followed by section 2 which comprises 57 items such as service quality, corporate image, perceived value, customer satisfaction, complaint, and customer loyalty. The items were measured using a five-point Likert-scale ranging from 1 as strongly disagree to 5 as strongly agree. Based on the Hair, Ringle, and Sarstedt (2011) stated that PLS-SEM minimum sample size should be equal to the larger of the following:

1. Ten times the largest number of formative indicators used to measure one construct or;
2. Ten times the largest number of structural paths directed at a particular latent construct in the structural model.

That guideline is called the 10 X rule (10-time rule of thumb) which is practically 10X of the maximum number of arrows or paths that hit a latent variable in the PLS model, so the minimum samples targeted are 100 respondents. This study used systemic random sampling to conduct a questionnaire survey. The questionnaires were distributed from 31 January to 7 February 2022. A total of 150 questionnaires are filled. After the data were sorted based on all the answered questions, there were 143 valid questionnaires used in the analysis.

6. Results and Discussion

In this section, we will discuss the respondent profile, PLS-SEM analysis from model evaluation until hypothesis testing, IPMA analysis for service quality dimension, and HoQ planning.

6.1 Respondent Profile

The final sample was made up of 65 women (45%) and 78 men (55%). In terms age, 20 respondents were aged 17–24 years (14%), 119 were aged 25–40 years (83%), and 4 were aged 41-56 years (3%). In terms of the respondent's frequency using MRT, 55% were MRT users once a month, 17% users were in 2 weeks, 17% users once a week, and 11% users more than once a week. For the full respondent's profile are presents in table 1.

Table 1. Respondent Profile

Item	Number	%
Gender		
Man	78	55%
Women	65	45%
Frequency		
>1 in a week	25	17%
Once a week	16	11%
Once in two weeks	24	17%
Once a month	78	55%
Age		
17 – 24 years old	20	14%
25 – 40 years old	119	83%
41 – 56 years old	4	3%
Income		
<2 million	5	3%
2 – 5 million	26	18%
5 – 8 million	57	40%
8 – 10 million	16	11%
>10 million	39	27%

6.2 Model evaluation

The examination in PLS-SEM method is consist of outer (measurement) and inner (structural) model evaluation to ensure that the model proposed is strong. Outer model is evaluated by using some tests namely convergent validity, discriminant validity, and internal consistency. The inner model is evaluated by using the score of coefficient determinant and goodness of fit. The first outer model evaluation is convergent validity. This study uses two indicators – score of factor loadings and Average Variance Extracted (AVE) to evaluate the convergent validity of the model. Following Hair et al's suggestion (2010), a construct should not have items which have score loading below 0.6. Therefore, pc2 which has a loading factor 0.577 respectively is deleted from the model. The estimation after deleting pc2 shows that all of constructs have factor loadings above the threshold value (0.6). Furthermore, the score of AVE is ranged more than 0.5 also indicates that all constructs do not have convergent validity problems which means each indicator has a high level of connection with its corresponding variable. Discriminant validity was evaluated using an approach proposed by Chin (2010). This approach suggests that none of the items should load more highly on another construct than it does on the construct it intends to measure. In other words, the value of the factor loading should be higher than the cross loadings. In this study, the value of the factor loading for each construct is higher than the cross loading. Therefore, it can be said that there is no discriminant validity. Another evaluation is the reliability of internal consistency, this evaluation is used to measure the extent to which indicators measuring the same construct are related to each other. One of the main measures used in PLS-SEM is the Jöreskog (1971) composite reliability. Cronbach's alpha is another measure of internal consistency reliability, which assumes the same threshold as composite reliability (rho). Table 2 and 3 are a summary of outer model evaluation result.

Table 2. Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Alternative Attractiveness	0.84	0.904	0.924	0.859
Assurance	0.923	0.929	0.937	0.653
Corporate Image	0.655	0.667	0.813	0.593
Empathy	0.881	0.889	0.913	0.677
Loyalty	0.812	0.816	0.914	0.841
Passenger Complaint	0.785	0.808	0.902	0.822
Passenger Satisfaction	0.833	0.844	0.923	0.857
Perceived Cost	1	1	1	1
Perceived Value	0.73	0.731	0.881	0.787
Reliability	0.907	0.916	0.927	0.647
Responsiveness	0.805	0.824	0.874	0.637
Service Quality	0.864	0.866	0.902	0.648
Switching Cost	0.771	0.844	0.861	0.675
Tangibility	0.929	0.933	0.94	0.611

Table 3. Loading Factor Value

Variable	Code	Items	Loading Factor
Responsiveness	rs1	Service personnel assistance	0.83
	rs2	Media social and call center admin	0.833
	rs3	Assistance, information, and complaint channel	0.864
	rs4	Quality of officers in providing information handling in emergency conditions	0.646
Empathy	e1	Provision and condition of worship space	0.768
	e2	Provision and condition of nursery room	0.79
	e3	Provision and condition of special need user facility	0.863
	e4	Friendly service personnel	0.852
	e5	Friendly security personnel	0.836
Tangibility	t1	Staff appearance	0.809
	t2	Clean Public facilities	0.805
	t3	Quality of vehicle	0.843
	t4	Information display at station	0.728

Variable	Code	Items	Loading Factor
	t5	Information displays onboard	0.79
	t6	Provision of lift and escalator	0.723
	t7	Provision and condition of toilets	0.83
	t8	Seating capacity and handrail	0.829
	t9	Station and onboard temperature	0.744
	t10	Provision and condition of bike facilities	0.701
Reliability	re1	Waiting time at station / train frequency	0.87
	re2	Punctuality	0.856
	re3	Travel time speed	0.828
	re4	Hours Service provision	0.829
	re5	Service interruption handling	0.823
	re6	Ticket selling channel	0.763
	re7	Taping and tap out process	0.64
Assurance	as1	Availability of information delays	0.828
	as2	Safety at station	0.852
	as3	Onboard safety	0.805
	as4	Station audio information	0.855
	as5	Onboard audio information	0.833
	as6	Personnel staff knowledge and skill provide information	0.862
	as7	Ride comfort	0.757
	as8	Noise	0.653
Service Quality	sq1	The service provided are responsive	0.779
	sq2	Friendly and caring staff in providing service	0.794
	sq3	Overall service facilities are well available	0.813
	sq4	Overall, the services provided are reliable	0.832
	sq5	Overall service provides a sense of security and comfort	0.806
Corporate image	ci1	MRT Jakarta is a safe, secure, and comfortable public transportation.	0.804
	ci2	MRT Jakarta is known as an operator that adheres to equality, gender inclusiveness, and is socially responsibility	0.811
	ci3	MRT Jakarta is a prestigious public transportation	0.688
Perceived Value	pv1	The Fare are reasonable for the services provided	0.883
	pv2	The service provided are valuable	0.892
Switching Cost	sw1	It would be a hassle for me to get information about other modes	0.824
	sw2	In my opinion other transportation services are more expensive	0.759
	sw3	It would be a high risk to travel by other modes	0.879
Perceived Cost	pc1	In my opinion, MRT fare is cheap	1
Passenger Satisfaction	ps1	I am satisfied with the overall service provided	0.915
	ps2	I am happy and enjoy travelling with MRT	0.936
Passenger Loyalty	pl1	I intend to continue traveling with MRT in the future	0.91
	pl2	I will recommend using MRT to others	0.925
Alternative Attractiveness	aa1	I would probably be more comfortable if using another mode	0.95
	aa2	I would probably be more satisfied if using another mode	0.903
Passenger Complaint	pt1	I have a complaint about the lack of MRT service	0.926
	pt2	MRT complaint handling is not good	0.887

As to the assessment of inner model, Hair et al. (2014) comment that the use of bootstrapping (5000 resamples) produces standard errors and confidence intervals to assess the statistical significance of the path coefficients. All the path coefficients in are shows in figure 3. The R-Squared of endogenous latent variables is an essential criterion for
assessing the structural model; a larger R-Squared indicates a better goodness-of-fit. Chin (1998) categorized the R-Squared values as substantial (>0.33), moderate (0.19–0.33), and weak (0.02–0.19), respectively. The R-squares values is present in table 4.

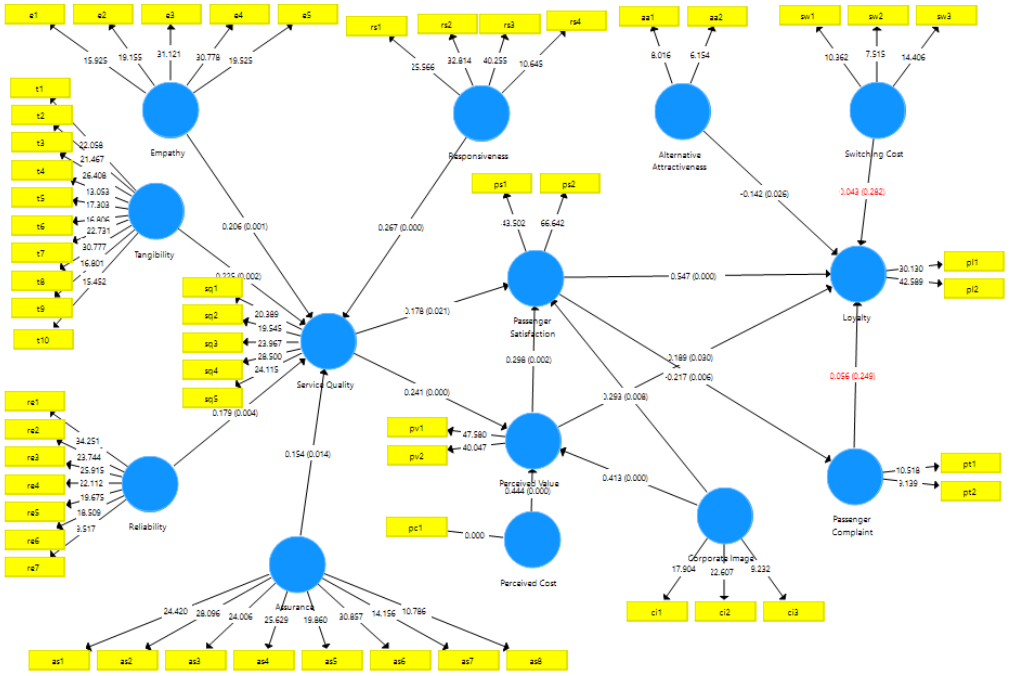

Figure 3. Path Coefficient

Table 4. R-Squared

	R Square	R Square Adjusted	Note
Service Quality	0.905	0.901	substantial
Loyalty	0.487	0.468	substantial
Passenger Satisfaction	0.414	0.401	substantial

6.3 Hypothesis Testing

Table 5. Hypothesis Testing

No	Hypothesis	Path Coeff	T-statistic	p-value	Result
H1a	RS -> SQ	0.267	4.366	0.0000	accepted
H1b	E -> SQ	0.206	3.174	0.0010	accepted
H1c	T -> SQ	0.225	2.987	0.0010	accepted
H1d	RE -> SQ	0.179	2.666	0.0040	accepted
H1e	AS -> SQ	0.154	2.077	0.0190	accepted
H2a	SQ -> PS	0.178	2.11	0.0180	accepted
H2b	SQ-> PV	0.241	3.713	0.0000	accepted
H3a	CI -> PS	0.293	2.437	0.0080	accepted
H3b	CI -> PV	0.413	5.586	0.0000	accepted
H4	PC--> PV	0.444	6.803	0.0000	accepted
H5a	PV-> PS	0.298	2.859	0.0020	accepted
H5b	PV -> PL	0.189	1.873	0.0310	accepted
H6a	PS -> PT	-0.217	2.405	0.0080	accepted
H6b	PS -> PL	0.547	6.275	0.0000	accepted
H7a	SW->PL	0.043	0.562	0.2870	rejected
H7b	AA -> PL	-0.142	1.99	0.0240	accepted
H8	PT->PL	0.056	0.691	0.2450	rejected

Parameter estimates obtained using the PLS-SEM specified above are provided in Table 5. The t-test was conducted to test the hypothesis paths. Due to the insignificance of the path coefficients, the assumed negative correlation between switching cost to passenger loyalty (H7a), and passenger complaint to passenger loyalty (H8) were not supported. Accordingly, this research hypothesis assumed that all the service quality has a positive and direct effect on perceived service quality (H1a, H1b, H1c, H1d, H1e). Service Quality has a positive and direct effect on passenger satisfaction (H2a) and has a positive and direct effect on passenger value (H2b). Corporate image has a positive and direct effect on passenger satisfaction (H3a) and perceived value (H3b), beside that perceived cost also have a positive and direct impact to passenger value (4b). Then, perceived value has a positive and direct effect on passenger satisfaction (H5a) and passenger loyalty (H5b), passenger satisfaction has a negative and direct effect on passenger complaint (H6a) but has a positive and direct impact to passenger loyalty (H6b), and alternative attractiveness has a positive and direct impact to passenger loyalty (H7b). These hypothesis paths were tested significantly in the model.

6.4 IPMA

Service quality indicators in the PLS model are considered as service quality attributes needed by public transport users. Apart from the PLS-SEM results of a structural model, IPMA helps PLS-SEM results through a four-quadrant diagram as depicted in Figure 4. The vertical axis represents the performance of the attributes from poor performance to good performance. IPMA is based on standardized regression coefficients (importance) and adds an additional dimension to the analysis that considers the values of the predictor variables, expressed here in terms of a scaled performance index from 0 to 100. The horizontal axis represents the importance of the attributes based on the total effect to the service quality as endogen variable. This score will be considered as the importance value on the voice of customer column in House of Quality matrix.

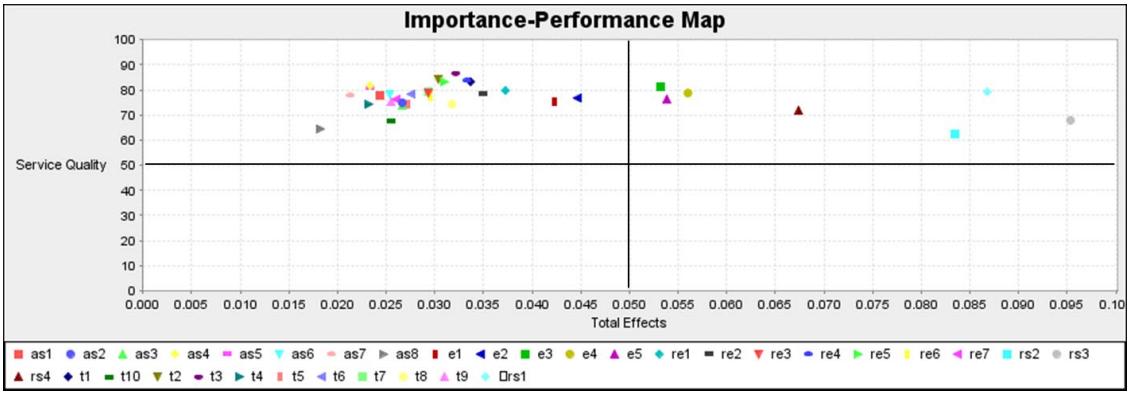

Figure 4. Importance-Performances Map

6.5 House of Quality

House of Quality (HoQ) is the initial stage in the application of QFD method. The quality house matrix tries to translate directly the consumer's assessment of the technical preconditions of a product or service produced. The SERVQUAL attribute on the PLS-SEM analysis will be analyze as customer needs in the HoQ Matrix (What's) and the importance value on each attribute will based on the IPMA analysis. The customer needs will be translated into technical response (How's) based on the interview with the related expert in MRT provider using HoQ phase 1. The matrix is present in table 6. After getting the technical response, it will elaborate into requirement matrix using HoQ phase 2. The requirement rank is present to the table 7.

Table 6. Technical Response of Customer Needs (What's and How's)

Code	Technical Response (How's)	Attribute (What's)	Weight	Rank
TR 1	Manpower performance (skill dan attitude)	rs1, rs2, rs4, e4, e5, re1, re2, re5, as4, as5, as6, as8	305.16	1
TR 2	Customer Relation Management	rs2, rs3, as1	94.84	5
TR 3	Infrastructure availability and performance	e1, e2, e3, t2, t6, t7, t9, t10, re5, re6, as4, as5, as8	92.02	6
TR 4	Standard Operating Procedure	rs1, rs2, rs4, e4, e5, t1, as6	95.31	4
TR 5	Frontliners grooming	t1, re2	32.16	11

TR 6	Availability of cleaning services	t2, t3	43.66	8
TR 7	Availability of security services	t3, as2, as3	40.53	9
TR 8	Availability of signage and information media	t4, t5, as1	52.11	7
TR 9	Train operation planning	re1, re2, re3, re4as7, as8	120.89	2
TR 10	Availability of Automatic Fare Collection System	re6, re7,	39.44	10
TR 11	Rollingstock availability and performance	e3, t3, t8, re1, re2, re3, re4, as2, as3, as7, as8	100.47	3

Table 7. Technical Requirements

Code	Requirement	Weight	Rank
PR1	Technical and soft skill training	355.4	1
PR2	Certification program	90.1	9
PR3	Sharing knowledge program	99.5	8
PR4	Coaching and evaluation	99.5	8
PR5	Availability of call center	84.0	11
PR6	Complain Handling Response	84.0	11
PR7	Availability of prayer room	27.2	22
PR8	Availability of lift and escalator	27.2	22
PR9	Availability of nursey room	27.2	22
PR10	Availability toilet	27.2	22
PR11	Availability bike rack	27.2	22
PR12	Availability of special need facilities	27.2	22
PR13	Availability of passenger information display	27.2	22
PR14	Availability of ATM	27.2	22
PR15	Availability passenger announcement system	27.2	22
PR16	Preventive and Corrective Maintenance	170.4	3
PR17	Availability of SOP and Work Instruction	166.0	4
PR18	Site Inspection	74.1	13
PR19	Availability of uniform	40.4	17
PR20	Implementation of service level agreement	74.5	12
PR21	Signage location	46.1	16
PR22	Signage legibility	46.1	16
PR23	Ridership demand evaluation (load factor)	107.0	5
PR24	Train driver availability	107.0	6
PR25	Train availability and reliability	196.0	2
PR26	Availability of passenger gate, TVM. QR code	62.1	14

7. Conclusion

The aim of this study is to assess the importance dimension of service quality and customer satisfaction on MRT passengers' behavior intention and selecting the strategy to improve customer satisfaction and loyalty. PLS-SEM can be used as a framework for predicting MRT customer satisfaction and behavior using the proposed research model. The result of hypotheses testing shows that among seventeen hypotheses proposed, fifteen hypotheses are accepted. All the service quality dimension has a positive and direct effect on perceived service quality. In line with that result, perceived service quality has a positive and direct effect on passenger satisfaction and passenger value. Both were mediation service quality into passenger loyalty. Using IPMA as extension analysis on PLS-SEM is establish in service quality dimension. So, the factors which influence the user satisfaction and behavior with MRT and several measures which might improve passenger satisfaction and loyalty were investigated. Based on the IPMA result, the responsiveness dimension has the lowest performance value with the highest level of importance. Then followed by the tangibility, empathy, reliability, and assurance dimension. Recommendations are given to MRT providers to make strategies to improve the quality of MRT services according to ability based on priority technical responses and requirements. The main five strategies to be implemented are: 1) conduct the technical and soft skill training for operation and maintenance staff, 2) improve train availability and reliability, 3) conduct preventive and corrective maintenance to maintain the reliability of train operation, 4) establish standard operating

procedure and work instruction and ensure all the personnel carrying out the procedures, 5) conduct ridership demand evaluation regularly to ensure that the operating pattern including the service hour and train headway provided is sufficient and comfortable to the passenger.

In practical terms, the findings of this study might also aid researchers or service providers in better identification of the factors that influence user satisfaction and loyalty to MRT services. This study also provides an evaluation of the service quality level and strategies to improve customer satisfaction and loyalty using a mixed analysis of PLS-SEM, IPMA, and QFD methods. There are also some limitations and more opportunities for future research. The first limitation of our study is that the study considers the limited scope of strategy that only focuses on service quality only. Besides that, further research is also being recommended to integrate the Quality Function Deployment method with the Kano model to establish more suitable strategies.

References

Ahmad, S., and Afthanorhan, W. M. A. B. W., The Importance-Performance Matrix Analysis in Partial Least Square Structural Equation Modeling (PLS-SEM) with Smartpls 2.0 M3, *International Journal of Mathematical Research*, *3*(1), 1–14, 2014.

Anderson, E. W., Fornell, C., and Rust, R. T., Customer satisfaction, productivity, and profitability: Differences between goods and services, *Marketing Science*, *16* (2), 129–145, 1997.

Bitner, M. J. and Hubbert, A. R., Encounter satisfaction versus overall satisfaction versus quality: the customer's voice. service quality: new directions in theory and practice, Thousand Oaks, CA: Sage (In Rust, R.T., and Oliver, R.L. (Eds.), 72-94, 1994.

Chin, W.W., How to Write Up and Report PLS Analyses. In: Esposito Vinzi, V., Chin, W.W., Henseler, J. and Wang, H., Eds., Handbook of Partial Least Squares: Concepts, Methods and Applications, Springer, Heidelberg, Dordrecht, London, New York, 655-690, 2010.

Cohen., Quality Fuction Deployment: How to Make QFD Work for You, Addison Wesley Publishing Co., Massachusetts, 1995.

Chowdhury, Hossan dan Mohammed., A multi-phased QFD based optimization approach to sustainable service design, Int. J. Production Economics171, 165–178, 2016.

de Oña, J., Estévez, E., and de Oña, R., Perception of Public Transport Quality of Service among Regular Private Vehicle Users in Madrid, Spain, *Transportation Research Record*, *2674*(2), 213–224, 2020.

Dinas Perhubungan DKI Jakarta., *Studi Review Rencana Induk Perkeretaapian Provinsi (RIPP) DKI Jakarta*, November 2021.

Eklof, J. A., Hackl, P., and Westlund, A. ,On measuring interactions between customer satisfaction and financial results. *Total Quality Management*, *10*(4–5), 514–522, 1999.

Fornell, C., Johnson, M. D., Anderson, E. W., Cha, J., and Bryant, B. E., American Customer Satisfaction Index : Nature , Purpose , and Findings, *Jurnal of Marketing*, *60*, 7–18, 1996.

Gronholdt, L., Martensen, A. and Kristensen, K., The Relationship between Customer Satisfaction and Loyalty: Cross-Industry Differences, Total Quality Management, 11, 509-514, 2000.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E., Multivariate Data Analysis. 7th Edition, Pearson, New York, 2010.

Hair, J. F., Ringle, C. M., and Sarstedt, M., PLS-SEM: indeed, a silver bullet. Journal of Marketing Theory and Practice, 19(2), 139–151, 2011.

Hair, J. F., Ringle, C. M., and Sarstedt, M., Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance. *Long Range Planning*, *46*(1–2), 1–12, 2013.

F. Hair Jr, J., Sarstedt, M., Hopkins, L. and G. Kuppelwieser, V., "Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research", *European Business Review*, Vol. 26 No. 2, pp. 106-121, 2014.

Höck, C., Ringle, C.M. and Sarstedt, M., 'Management of multi-purpose stadiums: importance and performance measurement of service interfaces', Int. J. Services Technology and Management, Vol. 14, Nos. 2/3, pp.188–207, 2010.

Hussain, H. D., Predicting the commuter's willingness to use LRT, utilising the theory of planned behaviour and structural equation, *Journal of Applied Engineering Science*, *18*(3), 403–412, 2020.

Ibrahim, A. N. H., Borhan, M. N., Yusoff, N. I. M., and Ismail, A, Rail-based public transport service quality and user satisfaction – a literature review, *Promet - Traffic - Traffico*, *32*(3), 423–435, 2020.

Jen, W., Tu, R., Lu, T., Managing passenger behavioral intention: an integrated framework for service quality, satisfaction, perceived value, and switching barriers. Transportation, 38, 321– 342, 2011.

Joreskog, K. G., Simultaneous factor analysis in several populations. *Psychometrika, 36*(4), 409–426, 1971

Luarn, P. and Lin, H.H., Toward an Understanding of the Behavioral Intention to Use Mobile Banking. Computers in Human Behavior, 21, 873-891, 2005.

Malle, A., and Yehualawork, A., Customer perceived value, satisfaction, and loyalty: the role of willingness to share information, *International Journal of Special Education*, *27*(2), 164–188, 2017.

Ni, A., Zhang, C., Hu, Y., Lu, W., and Li, H, Influence mechanism of the corporate image on passenger satisfaction with public transport in China, *Transport Policy*, *94, pp 54-65,* September 2019.

Oliver, R. L., *Satisfaction: a behavioral persepective on the customer* (2nd Edition), 2010.

Parasuraman, A., Zeithaml, V. A., and Berry, L. L., A Conceptual Model of Service Quality and Its Implications for Future Research. *Journal of Marketing*, *49*(4), 41, 1985.

Paulley, N., Balcombe, R., Mackett, R., Titheridge, H., Preston, J., Wardman, M., Shires, J., White, P, The demand for public transport: the effects of fares, quality of service, income and car ownership. Transport Policy, 13, pp. 295-306, 2006.

Presidential Regulation of the Republic of Indonesia No. 55, *Rencana Induk Transportasi Jakarta, Bogor, Depok, Tangerang, dan Bekasi, 2018.*

Putri, Y. A., Wahab, Z., Shihab, M. S., and Hanafi, A., The effect of service quality and brand trust on loyalty through customer satisfaction in transportation service Go-jek (go-ride) in Palembang City. *Jurnal Manajemen Motivasi*, *14*(1), 24, 2018.

Redman, L., Friman, M., Gärling, T., and Hartig, T., Quality attributes of public transport that attract car users: A research review. *Transport Policy*, *25*, 119–127, 2013.

Shen, W., Xiao, W., and Wang, X., Passenger satisfaction evaluation model for Urban rail transit: A structural equation modeling based on partial least squares. *Transport Policy*, *46*, 20–31, 2016.

Slack N., The importance-performance matrix as a determinant of improvement priority. Int J Oper Prod Manag 14:59–75, 1994.

Webb, V., *Customer Loyalty in the Public Transportation Context*, 18, 2010

Vicente, P., Sampaio, A., and Reis, E., Factors influencing passenger loyalty towards public transport services: Does public transport providers' commitment to environmental sustainability matter? *Case Studies on Transport Policy*, *8*(2), 627–638, 2010.

Yilmaz, V., Ari, E., and Oğuz, Y. E., Measuring service quality of the light rail public transportation: A case study on Eskisehir in Turkey. *Case Studies on Transport Policy*, *9*(2), 974–982, 2021.

Biographies

Amalia Hasanah Nur Ahlina is a Master's degree student in the Industrial Engineering Department, Faculty of Engineering Universitas Indonesia. She earned her bachelor's degree in Land Transportation from Sekolah Tinggi Transportasi Darat (STTD). Her field of interest is quality management, operation management, and transport planning. She is also a working professional in one of the public transport providers in Indonesia.

Dendi P Ishak, is a lecturer at the Industrial Engineering Department of Universitas Indonesia. He holds a Bachelor Engineering degree and a Master of Engineering Science degree in Industrial Engineering from Wayne State University USA. Mr. Dendi completed his Doctorate in Mechanical Engineering from Universiti Teknologi MARA Malaysia. His filed interest in organizational behaviour and design, industrial project management, Safety Engineering and Management, and Maintenance Management System.