Proceedings of the International Conference on Industrial Engineering and Operations Management
Manila, Philippines, March 7-9, 2023

A SERVQUAL Approach to Improving the Railway Experience Amidst Pandemic using Multi-Criteria Decision Making

Engr. Gabriel C. Bucu
Professor of Industrial Engineering
Faculty of Engineering, University of Santo Tomas
Manila, Philippines
gcbucu@ust.edu.ph

Xinjin Kendrik Araos, Ralph Erickson Balbin, Arjay Paul Dequito and Marcus Jericho Pineda
Industrial Engineering Department
Faculty of Engineering
University of Santo Tomas
Manila, Philippines
xinjinkendrik.araos.eng@ust.edu.ph, ralpherickson.balbin.eng@ust.edu.ph,
arjaypaul.dequito.eng@ust.edu.ph,
marcusjericho.pineda.eng@ust.edu.ph

Abstract

The Philippines is currently still in the midst of a pandemic, the Philippine railway systems such as the LRT and MRT are still part of the daily lives of commuters. In this context, this report surveys 400 commuters' insights and notions regarding the service quality provided by the Philippine Railway System. The SERVQUAL scale will be used to determine the commuters' insights and notions of proper service quality. Evaluating service quality is critical in order to boost passenger satisfaction and loyalty in riding a train in railways. It is essential for customers to maintain contentment and to increase morale. The study aims to recommend new policies to the railway system for the improvement of its quality service during pandemic and for the future purposes. Updates to the results of the interviewees' (customers') work are also required to make sure that the users' expectations and perceptions of the railway system's current internal and external performance, as well as its capacity to serve the general public (including the elderly and PWDs) and improve their facilities and equipment to do so, are plausible.

Keywords
SERVQUAL, Philippine Railway System, Quality Service, Pandemic and Commuters

1. Introduction

The Philippines saw its first railroad framework, harking back to the 1890s originally called the Ferrocarril de Manila-Dagupan. The line was reaching out from Manila to Dagupan in Pangasinan, covering 195 kilometers. It served as the path and bridge between the funding to the towns in the north of Luzon. Over a century after the fact, modernized train frameworks are all around the nation, serving different key regions and making business and exchange more helpful and effective. Today there are 3 different railway transports currently active. With over 20 kilometers of length, the elevated LRT-1 (Light Rail Transit 1) interfaces two urban areas in the capital district, Pasay and Caloocan City. There are 113 trains presently working, obliging a large portion of 116,021 travelers everyday and running at a speed of 60 kph. The LRT-2 (Light Rail Transit 2) with a 15-kilometer raised railroad framework, associates two Metro Manila urban communities, Pasig and Manila, crossing key areas in the locale. It serves around 200,000 travelers day to day running at a speed of 60 kph. Extending more than 16 kilometers and 45-60kph, this railway transport system fundamentally serves the critical urban communities of Metro Manila, as the MRT (Metro Rail Transit) course interfaces the north and south of the capital area. The first ridership limit of the train was 350,000 every day, except

in 2016, it crested to a large portion of 1,000,000, as the movement season of trains expanded. As a result, there are no physical or technical obstacles between railway transportation and integrated public vehicles, which can be used whenever the need arises. Even if there were new systems in place to prevent COVID-19, mass overload on the railroads is still one of the issues that every railway service in the Philippines deals with, making it challenging to keep oneself apart from another, there are a total of 21 MRT trains operating in the vehicle base. There are jobs, errands, schools, and other locations that Filipinos must attend. Despite the country being in the midst of a widespread pandemic, the Philippine train system is still one of the most popular forms of transportation in the country today. Commuters and train system personnel noticed social distance during this epidemic crisis. Due to the Pandemic, LRT 1 now has an average of 66,550 daily users, LRT 2 has 49,596 daily riders, and MRT 3 has 39,187 daily riders. It is crucial to remember that health precautions play a crucial role in visitors' psyche and affect their likelihood of creating a thoughtful plan for individual mobility against the current vulnerabilities and the apprehension about intimacy socially, even past the possible risk. Factor analysis is particularly useful for reducing a large number of linked variables to a manageable number by removing a small number of factors using multiple regression and multivariate analysis of variance. It might come in handy when making a questionnaire.

It focuses on the Analytic Hierarchy Process (AHP), one of the MCDM methods, and demonstrates that it is very likely to produce a list of possibilities that a rational person would find unacceptable. Multi-criteria decision making, or MCDM, is a tool in operations research. In recent years, extensive research has been conducted on the theoretical and practical aspects of MCDM and fuzzy MCDM. The algorithms of the well-known MCDM processes (AHP and TOPSIS) are discussed, as are their applications in the grading and selection of cotton fiber. To ascertain the commuters' perceptions and ideas of appropriate service quality, the SERVQUAL scale will be employed. In order to increase passenger happiness and loyalty when riding a train in the railroad industry, it is essential to evaluate service quality. Maintaining client satisfaction and raising morale are crucial for business success. In order to improve the quality of service provided during the pandemic and for future purposes, the study will make recommendations for new policies and a better addition to the Philippine railway system. It also tries to pinpoint any discrepancies between what customers expect from the railways and what they actually deliver. The purpose of the study is to learn more about the railway system. One of the approaches that will be taken in this study is Basic Inquiries. It is a survey and interviews with commuters as well as employees and officials of the Philippine Railway System.

1.1 Objectives

The Philippine Railway System is transportation where commuters ride from places to places. It also identifies factors that can improve the service quality towards its commuters in the railway. The issues in the system of the railway will be pointed out and there is new available knowledge in this study. The researchers' aims to fulfill the objectives, these Objectives are:

1. Determine the background history of Philippine National Railways
2. Identify the factors of deficiency in the railway system in terms of quality service
3. Identify the customers delivered rate and expectation to the service of the Railway
4. Identify the research questions and methods for conducting the surveys
5. Conduct a survey to the commuters of railway to accumulate information regarding the commuter's perceptions
6. Provide reliable recommendations on improving the service and flow of commuters in railway transportation (Time, Directions, System, Behaviors).
7. Provide reliable recommendations on improving service, policies, and rules in railway transportation when facing the pandemic crisis.

2. Literature Review

Tardiyo et al. (2021) As much as the pandemic had negative impacts on different sectors, it also had consequences for the environment: greenhouse gas emissions (GHG) have decreased and air quality has increased. Contingency measures have indeed been associated with improvement in air quality, clean beaches, and environmental noise reduction. Guzman et.al, (n.d.) accounted for the effects of the COVID-19 pandemic on the decisions of users and drivers to avail or operate under transportation network vehicle systems (TNVS). A conceptual framework was created that considers variables such as value, comfort, convenience, reliability, and security associated with users and drivers under TNVS and the situation regarding the COVID-19 pandemic. In determining the impact of COVID-19 on the operations of TNVS in Metro Manila, Sia et.al, (n.d.) concluded that results have shown that there were no significant differences in the perception of users and drivers towards TNVS when the pandemic started, particularly around Metro Manila.

Kaampeerawat et al. (2017) aims to design a timetable and an energy system storage by minimizing the energy that is supplied from a substation and the capacity of the energy saving system. Adjusting the parameters of the time table such as running time and dwell time was used to maximize regenerative energy to achieve energy efficiency. An optimization problem with multi-objective function was designed and is expressed by an equation. Due to having complicated constraints such as braking effort, motor efficiency, gradient, curvature, speed limit, etc. Genetic Algorithm is selected in order to solve this problem. The Facility Management System of the Philippine National Railways concludes to have certain issues to be improved and these are free loading passengers, passenger management, long queues and safety issues. (Andrada et al. 2020). This study obtains specific factors that will be evaluated in order to have a precise result, statistical tools and other related literature. The design of the upgraded station facility management system used by Industrial Engineering methods such as quality function deployment (QFD), queuing theory, systematic layout planning (SLP), and processes.

The evaluation used in interviews and surveys are Facility Performance Evaluation or FPE. Through this evaluation, the researchers identify the factors and these are security, system, platform capacity and circulation area. These factors are the unsatisfactory or poor services of the Philippine National Railways. Using ServQual these factors were classified and determined. The SERVQUAL model offers an option in contrast to resource intensive self-study approaches on ways to deal with projects that can be used to work on bettering their performance and limit the gaps between expectations and perceived functioning. This permits service organizations with comparative results to offer more prominent benefits, competitiveness, opportunities for development in administrations, and expansion in consumer loyalty. The examination of Service Quality is of vital significance for the administrators and the transportation system, as the expansion in ServQual in transportation has been displayed to assume a vital part in drawing in new passengers from private vehicles to the public vehicle framework and in decreasing traffic pollution as a result (Transportation Research Board 1999).

3. Methods

The instrumentation will use the analytic hierarchy process method, wherein surveys will be conducted in order to analyze each SERVQUAL factor and its variables to discern the overall service quality of the railway system. Customer satisfaction regarding dimensions of reliability, assurance, tangibility, empathy, and responsiveness will be measured with the use of a multi-criteria decision analysis, which assesses the performance, effects, and/or impacts of the railway service quality. A technique called analytic hierarchy process (AHP) is quantifying its criteria, providing alternative options, and connecting those components to the overall objective. AHP offers a rational framework for a decision that is necessary. After gathering data and results from the ServQual application, the results from the AHP model would then be used to find the impact of each criteria from the ServQual framework which would help to come up with the optimal recommendation in helping improve the experience of a common train commuter. The questionnaire is based on the SERVQUAL framework and is shown on the table below. This would measure the weight of each variable by using a Likert Scale ranging from (1-6) in answering the survey questions.

Table 1. Survey Questionnaires

A. Reliability	Expected On a scale of 1-6, rate the importance of each section	Perceived On a scale of 1-6, how satisfied/confident are you with the following
1. Travel time to each station		
2. Process of buying tickets or topping up cards		
3. Time schedule when the train arrives		
4. Health and safety protocols that the railway system provides and requires		
5. Speed of service of a train ride		
B. Assurance	Expected	Perceived
1. Travel safely to your destination when using the train		

2. Information systems in train stations		
3. Assurance that the train that you are riding would be safe		
4. A seat would be available for you when you go inside a train		
C. Tangibles	Expected	Perceived
1. Light, noise level and temperature of a station		
2. Type of ticket/passes that train station have		
3. Seating capacity of trains		
4. Elevators and ramps that are for the elderly and people with disabilities		
D. Empathy	Expected	Perceived
1. Service personnel attitude in the train station		
2. Air conditioning that the station provides		
3. The process of temperature check and provided disinfection kits such as alcohol		
4. Giving individual attention to those who need help		
5. Policies that prioritizes elderly and person with disabilities (PWD)		
E. Responsiveness	Expected	Perceived
1. transportation policies during pandemic		
2. Response to the passengers and their complaints		
3. On-board information		
4. Adjustments on long-queues during rush hours		

4. Data Collection

According to Philippine News Agency, a total of 2,799,025 passengers have been using the 4 railway services in Metro Manila since the resumption of operation during the general community quarantine (GCQ) in June 2020. Using Slovin's formula, the researchers have computed a minimum sample size of 385 with a margin of error of 5% and confidence level of 95%. An online and an actual survey would be conducted and distributed using the likert scale in order to evaluate the factors of service quality affecting the rider's satisfaction of the Philippine railway systems. The survey is divided into five dimensions of service quality which are reliability, assurance, tangible, empathy and responsiveness. It measures the perceptions and expectations of the commutes in Philippine Railways. The total questions are twenty-two for the survey with 5 questions each for reliability and empathy while 4 questions each on assurance , empathy and responsiveness.

The online survey would be spread out through social media platforms such as facebook, instagram, and twitter since nowadays almost the whole population uses these platforms for communication, work, studies, entertainment, etc. The physical survey would be spread out physically, handed out to time-available railway riders at the train stations and collected right after they answer. This study would conduct a research based approach and not an experimental one. After collecting the data and results from the survey, the weight of each part would be computed by getting the average of each part and it would be ranked from highest to lowest. Then an assessment would be made basing from the rankings to where the recommendation of guidelines must be focused for a better and improved service quality given by the railway system. By using Kardi Teknomo's published book "Analytic Hierarchy Process (AHP) Tutorial", the

researchers determined the relative weights of each criteria and sub-criteria. Multi-criteria decision-making (MCDM), specifically the Analytic Hierarchy Process (AHP) was used in the process. The Main Criteria and Subcriteria's relative weights were identified. The Main Criteria includes the Reliability, Assurance, Tangibles, Empathy, and Responsiveness. While the sub-criteria includes all the questions asked in the survey under each of the Main Criteria.

5. Results and Discussion

5.1 Numerical Results

In the SERVQUAL survey, the researchers used Likert scale to answer the questionnaire. The researchers computed the average from each subcriteria for Expected and Perceived. We also calculate the differences of expected and perceived and rank them from highest to lowest in order to identify the gap for each subcriteria.

Figure 1. Results of the Survey

The criteria on the survey questionnaire are (6 -Strongly Agree, 5 - Agree, 4 - Slightly Agree, 3 - Slightly Disagree, 2 - Disagree, 1 - Strongly Disagree).

5.2 Graphical Results

To standardize the relative weight after the summations, the researchers divided each matrix element by the sum of its corresponding column. Each column's total should be "1." As observed in Table 2 to 6. The researchers averaged each row after normalizing the weights to obtain the relative weights of each item.With the gathered data from the 400 respondents the researchers along with their adviser decided how to interpret the average rankings of importance for each main and sub-criteria into the value of how each criteria is 'more important' than the other based on the published book. Since the results from the distributed survey showed different values of averages, the researchers ranked which specific criteria's were the most to least important based on the survey questionnaires (Table 1). Comparing the most to least important factor would then mean the following: 1st vs 5th = 9 times more important, 1st vs 4th = 7 times more important, 1st vs 3rd = 5 times more important, 1st vs 2nd = 3 times more important. (4 rank difference = 9 times more important, 3 rank difference = 7 times more important, 2 rank difference = 5 time more important, 1 rank difference = 3 times more important)

Table 2. Sub-Criteria Pair-wise Comparison Main Criteria

	Main Criteria				
	Reliability	Assurance	Tangibles	Empathy	Responsiveness
Reliability	1	1/3	1/5	1/7	1/9
Assurance	3	1	1/3	1/5	1/7
Tangibles	5	3	1	1/3	1/5
Empathy	7	5	3	1	1/3
Responsiveness	9	7	5	3	1

	Main Criteria				
	Reliability	Assurance	Tangibles	Empathy	Responsiveness
Reliability	1	1/3	1/5	1/7	1/9
Assurance	3	1	1/3	1/5	1/7
Tangibles	5	3	1	1/3	1/5
Empathy	7	5	3	1	1/3
Responsiveness	9	7	5	3	1
Total	25	16 1/3	9 1/2	4 2/3	14/5

	Main Criteria				
	Reliability	Assurance	Tangibles	Empathy	Responsiveness
Reliability	0.04	0.02	0.02	0.03	0.06
Assurance	0.12	0.06	0.03	0.04	0.08
Tangibles	0.20	0.18	0.10	0.07	0.11
Empathy	0.28	0.31	0.31	0.21	0.19
Responsiveness	0.36	0.43	0.52	0.64	0.56
Total	1	1	1	1	1

Main Criteria	
Reliability	0.03
Assurance	0.07
Tangibles	0.13
Empathy	0.26
Responsiveness	0.50
Total	1.00

Table 3. Sub-Criteria Pair-wise Comparison Reliability

	Health and Safety Protocols	Process of Buying Ticket	Time Schedule	Travel Time to Each Station	Speed of Service
Health and Safety Protocols	1	1/3	1/5	1/7	1/9
Process of Buying Ticket	3	1	1/7	1/5	1/3
Time Schedule	5	7	1	1/5	1/3
Travel Time to Each Station	7	5	5	1	1/3
Speed of Service	9	3	3	3	1

	Health and Safety Protocols	Process of Buying Ticket	Time Schedule	Travel Time to Each Station	Speed of Service
Health and Safety Protocols	1	1/3	1/5	1/7	1/9
Process of Buying Ticket	3	1	1/7	1/5	1/3
Time Schedule	5	7	1	1/5	1/3
Travel Time to Each Station	7	5	5	1	1/3
Speed of Service	9	3	3	3	1
Total	25	16 1/3	9 1/3	4 1/2	2 1/9

	Health and Safety Protocols	Process of Buying Ticket	Time Schedule	Travel Time to Each Station	Speed of Service
Health and Safety Protocols	0.04	0.02	0.02	0.03	0.05
Process of Buying Ticket	0.12	0.06	0.02	0.04	0.16
Time Schedule	0.20	0.43	0.11	0.04	0.16
Travel Time to Each Station	0.28	0.31	0.54	0.22	0.16
Speed of Service	0.36	0.18	0.32	0.66	0.47
Total	1	1	1	1	1

Health and Safety Protocols	0.03
Process of Buying Ticket	0.08
Time Schedule	0.19
Travel Time to Each Station	0.30
Speed of Service	0.40
Total	1.00

Table 4. Sub-Criteria Pair-wise Comparison Assurance

	Travel Safetly	Assurance that the train is safe	A seat would be available	Information systems in train station
Travel Safetly	1	1/3	1/5	1/7
Assurance that the train is safe	3	1	1/3	1/5
A seat would be available	5	3	1	1/3
Information systems in train station	7	5	3	1

	Travel Safetly	Assurance that the train is safe	A seat would be available	Information systems in train station
Travel Safetly	1	1/3	1/5	1/7
Assurance that the train is safe	3	1	1/3	1/5
A seat would be available	5	3	1	1/3
Information systems in train station	7	5	3	1
Total	16	9 1/3	4 1/2	1 2/3

	Travel Safetly	Assurance that the train is safe	A seat would be available	Information systems in train station
Travel Safetly	0.06	0.04	0.04	0.09
Assurance that the train is safe	0.19	0.11	0.07	0.12
A seat would be available	0.31	0.32	0.22	0.20
Information systems in train station	0.44	0.54	0.66	0.60
Total	1	1	1	1

Travel Safetly	0.06
Assurance that the train is safe	0.12
A seat would be available	0.26
Information systems in train station	0.56
TOTAL	1.00

Table 5. Sub-Criteria Pair-wise Comparison Tangibles

	Elevators and Ramps that are for the Elderly	Type of Ticket/Passes	Seating Capacity	Light, Noise Level and Temperature
Elevators and Ramps that are for the Elderly	1	1/3	1/5	1/7
Type of Ticket/Passes	3	1	1/3	1/5
Seating Capacity	5	3	1	1/3
Light, Noise Level and Temperature	7	5	3	1

	Elevators and Ramps that are for the Elderly	Type of Ticket/Passes	Seating Capacity	Light, Noise Level and Temperature
Elevators and Ramps that are for the Elderly	1	1/3	1/5	1/7
Type of Ticket/Passes	3	1	1/3	1/5
Seating Capacity	5	3	1	1/3
Light, Noise Level and Temperature	7	5	3	1
Total	16	9 1/3	4 1/2	1 2/3

	Elevators and Ramps that are for the Elderly	Type of Ticket/Passes	Seating Capacity	Light, Noise Level and Temperature
Elevators and Ramps that are for the Elderly	0.06	0.04	0.04	0.09
Type of Ticket/Passes	0.19	0.11	0.07	0.12
Seating Capacity	0.31	0.32	0.22	0.20
Light, Noise Level and Temperature	0.44	0.54	0.66	0.60
Total	1	1	1	1

Elevators and Ramps that are for the Elderly	0.06
Type of Tickets/Passes	0.12
Seating Capacity	0.26
Light, Noise Level and Temperature	0.56
TOTAL	1.00

Table 6. Sub-Criteria Pair-wise Comparison Empathy

	Policies the Prioritizes Elderly	The Process of Temperature Check	Giving Individual Attention	Air Conditioning	Service Personnel Attitude
Policies the Prioritizes Elderly	1	1/3	1/5	1/7	1/9
The Process of Temperature Check	3	1	1/3	1/5	1/7
Giving Individual Attention	5	3	1	1/3	1/5
Air Conditioning	7	5	3	1	1/3
Service Personnel Attitude	9	7	5	3	1

	Policies the Prioritizes Elderly	The Process of Temperature Check	Giving Individual Attention	Air Conditioning	Service Personnel Attitude
Policies the Prioritizes Elderly	1	1/3	1/5	1/7	1/9
The Process of Temperature Check	3	1	1/3	1/5	1/7
Giving Individual Attention	5	3	1	1/3	1/5
Air Conditioning	7	5	3	1	1/3
Service Personnel Attitude	9	7	5	3	1
Total	25	16 1/3	9 1/2	4 2/3	14/5

	Policies the Prioritizes Elderly	The Process of Temperature Check	Giving Individual Attention	Air Conditioning	Service Personnel Attitude
Policies the Prioritizes Elderly	0.04	0.02	0.02	0.03	0.06
The Process of Temperature Check	0.12	0.06	0.03	0.04	0.08
Giving Individual Attention	0.20	0.18	0.10	0.07	0.11
Air Conditioning	0.28	0.31	0.31	0.21	0.19
Service Personnel Attitude	0.36	0.43	0.52	0.64	0.56
Total	1	1	1	1	1

Policies the Prioritizes Elderly	0.03
The Process of Temperature Check	0.07
Giving Individual Attention	0.13
Air Conditioning	0.26
Service Personnel Attitude	0.50
Total	1.00

Table 7. Sub-Criteria Pair-wise Comparison Responsiveness

	Response to Passengers and their	On-Board Information	Adjustments on Long Queues during Rush	Tranportation Policies during Pandemic
Response to Passengers and their	1	1/3	1/5	1/7
On-Board Information	3	1	1/3	1/5
Adjustments on Long Queues during Rush	5	5	1	1/3
Tranportation Policies during Pandemic	7	3	3	1

	Response to Passengers and their	On-Board Information	Adjustments on Long Queues during Rush	Tranportation Policies during Pandemic
Response to Passengers and their	1	1/3	1/5	1/7
On-Board Information	3	1	1/3	1/5
Adjustments on Long Queues during Rush	5	5	1	1/3
Tranportation Policies during Pandemic	7	3	3	1
Total	16	9 1/3	4 1/2	1 2/3

	Response to Passengers and their	On-Board Information	Adjustments on Long Queues during Rush	Tranportation Policies during Pandemic
Response to Passengers and their	0.06	0.04	0.04	0.09
On-Board Information	0.19	0.11	0.07	0.12
Adjustments on Long Queues during Rush	0.31	0.54	0.22	0.20
Tranportation Policies during Pandemic	0.44	0.32	0.66	0.60
Total	1	1	1	1

Response to Passengers and their	0.06
On-Board Information	0.12
Adjustments on Long Queues during Rush	0.32
Tranportation Policies during Pandemic	0.50
TOTAL	1.00

After the process, the researchers calculated each of the main and sub-criteria relative weights. For the main criteria, Reliability came first with a relative weight of 0.03, Assurance came second with a relative weight of 0.07, Tangibles came third with a relative weight of 0.13, Empathy came fourth with a relative weight of 0.26, and Responsiveness came 5th with a relative weight of 0.50 which all in all totals to 1.00.

5.3 Proposed Improvements

The researchers provide one (1) solution per criteria/dimension to provide the gaps and improvement on the factors under each criteria. The researchers interviewed five (5) commuters of LRT/MRT Line 1-3 via call and chose the best alternative solution for each criteria. A pretotype is created on the five (5) alternative solutions for each criteria. According to (Ponomarev, 2019.) accelerate learning by building a quick and cheap version of your product. For the criteria of Reliability the alternative solution is to keep a high-quality standard of operations by using methods such as timetable construction. For the criteria of Assurance, "Quality equipment and overall process efficiency" was chosen as the best alternative solution. For the criteria of Tangibles the best alternative solution is “Strategic planning to determine internal performance of the railway transport system.” For the criteria of Empathy, the interviewers and researchers conclude that Provision of travel information access, boarding-alighting, support for disabled users, and the like are the best solutions. In the criteria of Responsiveness, a “Direction and Notice Boards for limiting unnecessary issues for customers' ' is the best alternative solution and a pretotype was developed as a Transit Board Information.

Keep high-quality standard of operations by using methods such as timetable construction is an addition to the common operating schedule of LRT and MRT that only shows the time of the first train and the last train, a time in which a train would arrive and depart in a station should also be shown and updated in real-time to improve the quality of life of commuters. With this, a timetable app would be created that includes train arrival time for a specific station. The steps are as follows: A user would select from a drop-down menu if he/she would take LRT-1, LRT-2, MRT-1, or MRT-2. A specific station would be selected in the chosen line. An estimated arrival time would be shown in the app. For example, if a user would take a station from LRT-1, two arrival times would be shown, one going to Baclaran and another going to Roosevelt. A sample of the application content would be shown in the following table and a user from that would take a train from Monumento Station is assumed.

Quality equipment and overall process efficiency is a form of quality assurance application called Tren Check is made. It is an application and a QR Code scanner dedicated to informing users of the railway system on the status of the train's equipment now. Every train (LRT/MRT) is physically equipped with a QR Code sticker that people will scan using the application. After doing so, the application would display the following aspects of the train, along with statuses showing their current efficiency. As it stands, current mobile applications only allow people to know the travel information, estimated fare, map, and other aspects of concern. What it does not contain is assuring customers that they can travel safely to said destination. This application aims to do exactly that. Since railway systems undergo quality control and provide daily status reports before, during, and after operations, such an application informing users of the equipment's' status is not an impossible feat. Should it be implemented, railway users will become more at ease in using the railway system, as they receive firsthand details on its overall capabilities at the time of their boarding.

Strategic planning to determine internal performance of railway transport system helps ensure Tangibles (physical quality) receive adequate attention for servicing these customers who are also users of the railway system, a survey will be developed, which users will have an option to accomplish whenever they tap/insert their card in their designated station.

Table 8. Sample Customer Quality Survey

1. The quality of our equipment.	9. The accuracy of our records.	17. The ability of our employees to answer your questions.
2. The appearance of our physical facilities.	10. Telling you exactly when services will be performed.	18. The individual attention you received from us.
3. The appearance of our employees.	11. Receiving prompt service from our employees.	19. The convenience of our operating hours.
4. The appearance of our materials (pamphlets, statements, etc.)	12. The willingness of our employees to help you.	20. The personal attention you received from our employees.
5. Delivering on promises to do something by a certain time.	13. Never being too busy to respond to your requests.	21. Having your best interests at heart.
6. The sincerity of our interest in solving your problems	14. Employee actions that instill confidence in you.	22. The ability of our employees to understand your specific needs.
7. Performing service right the first time.	15. The safety you feel in transactions with our employees.	23. How would you rate the overall service you received?
8. Providing services at the time we promise to do so	16. The courteousness of our employees.	24. Considering the time, effort and money you spent with us, how would you rate the overall value provided?

Provision of Travel Information access, boarding, alighting, support for disabled users, and minorities will help LRT and MRT users contain the elderly and people with disabilities. Since there are certain policies to be followed by everyone, it would be difficult for some of them to keep up. This section suggests to provide different entries & exit pathways for PWD and Elderly and not just a separate train vehicle.

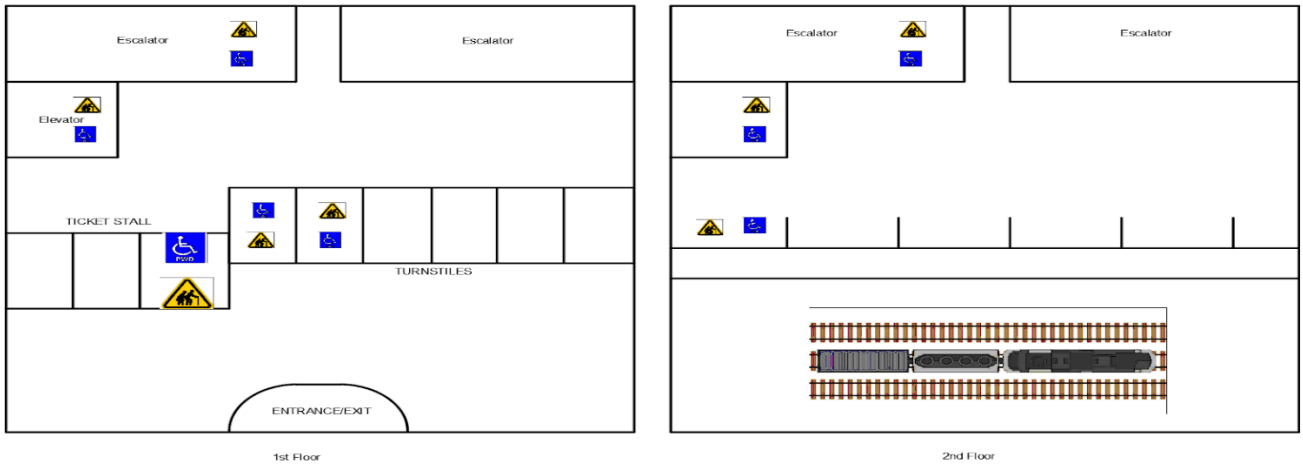

Figure 2. Sample Illustration of Separate Designated Elderly/PWD Paths, Booths, Entrances, & Exits.

Direction and Notice Boards for limiting unnecessary issues for customers gives improvement to the railway system. The transit on board information design to improve the connection between the railway system and to the commuters. This board consists of a big clock time and also the exact time when the train arrives. It is better than the estimated upcoming arrival that the LRT and MRT Lines have now. It also gives the destination of the train and also the directions where a commuter will turn. The next attribute of this on board information is the status of the train. Commuters can now anticipate the arrival time of the train that can help them in rush hours. In the status tab, it will state if the rain is boarding, on-time or late on its original arrival time. It also gives the information where there are available seats left or none for the upcoming train. For the new policies implemented due to changes of policies during pandemic, there is an announcement area on the lowest part of the board. For the concerns of commuters, all the hotlines of LRT/MRT Lines will be visible on the board information and the front desk where a commuter can complain or inquire.

Figure 3. Sample of LRT/MRT Board Information

6. Conclusion

To lessen the hassle of using the Philippine Light Rail System and Metro Rail System, the researchers considered the 5 main criteria, Reliability, Assurance, Tangibility, Empathy, and Responsiveness. The researchers achieved the objectives from the start up until the end. The study proposed five best alternative solutions to the railway system which are the main objectives of this study. By using different methods of data collection, it is shown and proven that

there are multiple factors regarding Philippines' rail transportation that need improvement and updates. This is proven based on the survey conducted. By performing multiple tests such as AHP to identify and rank the average weights of the problem commuters are encountering, multiple alternate solutions are to be provided for commuters to receive 100% satisfaction and avoid more problems.

References

Andrada, M., Alfaro, B., and Cruz, J., *Facility Management System Improvement of the Philippine National Railways,* Available: http://www.ieomsociety.org/ieom2020/papers/271.pdf. 2020.

Aranguren, M., Candelaria, J., De Guzman, J., Roquel, K., and Sia, A., *Impact of the COVID-19 Pandemic on the Operations of Transportation Network Vehicle Services (TNVS) in Metro Manila*, Available: http://ncts.upd.edu.ph/tssp/wp-content/uploads/2021/12/09-TSSP2021-Impact-of-COVID19-pandemic-to-TNVS-operations-in-NCR.pdf, 2021.

Asadabadi, R., Chang, E., and Saberi, M., *Are MCDM methods useful? A critical review of Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP). Cogent Engineering,* 6(1), Available: https://doi.org/10.1080/23311916.2019.1623153. 2019.

Bandara, A. and Perera, R. *The Impact of Railway Transport Service Quality on Passengers' Satisfaction: A Study based on Kandy Railway Station. International Conference on Contemporary Management*, ICCM-2016, 678-692,Available:https://www.researchgate.net/publication/334596352_THE_IMPACT_OF_RAILWAY_TRANSPORT_SERVICE_QUALITY_ON_PASSENGERS%27_SATISFACTION_A_STUDY_BASED_ON_KANDY_RAILWAY_STATION. 2016.

Bigotte, J., Ferranti, E., Ferreira, A., Mejia, A., Hasselwander, M., and Tamagusko, T., *Building back better: The COVID-19 pandemic and transport policy implications for a developing megacity. Sustainable Cities and Society 69*, Available: https://www.uc.pt/covid19/documentos/Buildingbackbetter_TheCOVID19pandemicandtransportpolicyimplicationsforadevelopingmegacity, 2021.

Canicosa, T., Custodio, B., Guzman, B., Medina, J., and Portus, J., *Usability Evaluation of Ticketing System of Metro Manila Train Network. Advances in Intelligent Systems and Computing*, 591–602, Available: https://doi.org/10.1007/978-3-319-60492-3_56, 2017.

Chua, S., *Feasibility improvement of transportation for light rail train system, 2018 5th International Conference on Business and Industrial Research (ICBIR)*, Available: https://doi.org/10.1109/icbir.2018.8391196. 2018.

Cruz, D., Estacio, G., Pagtalunan, S., Tolentino, S., and Valenzuela, C., *Innovations on Advanced Transportation Systems for Local Applications, IEEE 11th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM)* (pp. 1-6). IEEE. 2019.

Cruz, D., *4 Metro Manila rail lines transport 2.8M passengers since June 1. Philippine News Agency,* Available: https://www.pna.gov.ph/articles/1107039#:~:text=For%20June%2C%20the%20average%20daily,2019%20were%20280%2C000%20to%20300%2C000, 2020.

Eboli, L., and Mazzulla, G., *A stated preference experiment for measuring service quality in public transport. Transportation Planning and Technology*, Available: https://www.tandfonline.com/doi/full/10.1080/03081060802364471, 2008.

Guner, S., Taskin, G., Cebeci, H. and Aydemir, E., *Service quality in rail systems: listen to the voice of social media. Research Square,* Available: https://doi.org/10.21203/rs.3.rs-1980183/v1, 2022.

Hagen, M., and Oort, N., *Improving railway passengers experience: two perspectives. Journal of Traffic and Transportation Engineering*, 7(3), 2328-2142, 2019.

Ibrahim, A., Borhan, M., Yusoff, N., and Ismail, A., *RAIL-BASED PUBLIC TRANSPORT SERVICE QUALITY AND USER SATISFACTION – A LITERATURE REVIEW, Promet - Traffic & Transportation* 32(3), 423-435, 2020.

Irfan, S., Hung Kee, D., and Shahbaz, S., *Service Quality and Rail Transport in Pakistan: A Passenger Perspective.* World Applied Sciences Journal 18(3), 361-369, 2012.

Jen, W., Tu, R., and Lu, T., *Managing passenger behavioral intention: An integrated framework for service quality, satisfaction, perceived value, and switching barriers,* Available: https://doi.org/10.1007/s11116-010-9306-9, 2011.

Jiang, Y., Chen, L., and Go, E., *Accessibility analysis of the South Commuter Railway project of the Philippine,.* ADB Briefs No. 185. Available: https://doi.org/10.22617/brf2101314-2, 2021.

Kampeerawat, W., and Koseki, T., *A strategy for utilization of regenerative energy in urban railway system by application of smart train scheduling and wayside energy storage system. Energy Procedia*, 138, 795–800. 2017.

Kondratiev, V., Olentsevich, V., Kuznetsov, B., and Karlina, A., *Improving the quality of the railway transportation process,* Northern Sustainable Development Forum 2020, 112, 1-7, 2021.

J. Li, X. Xu, Z. Yao and Y. Lu, *Improving Service Quality With the Fuzzy TOPSIS Method: A Case Study of the Beijing Rail Transit System*. *IEEE Access*, vol. 7, pp. 114271-114284, 2019.

Martin, C., Tardivo, A., and Zanuy, A., *COVID-19 Impact on Transport: A Paper from the Railways' Systems Research Perspective, COVID-19 and Transportation* 2675(5), 367-378, 2021.

Niu, H., Yao, J., Zhao, J., and Wang, J., *SERVQUAL Model Based Evaluation Analysis of Railway Passenger Transport Service Quality in China. Journal on Big Data*, Available: https://doi.org/10.32604/jbd.2019.05799, 2019.

Ocampo, L., Alinsub, J., Casul, R., Enquig, G., Luar, M., and Panuncillon, N., *Public service quality evaluation with SERVQUAL and AHP-TOPSIS: A case of Philippine government agencies, Socio-Economic Planning Sciences,* 68, 100604. Available: 10.1016/j.seps.2017.12.002. 2019.

Pandey, A., *Progressive RAMS Assurance & Management for Railway Projects. Rail Safety and Reliability – A Global Perspective*, Available: 10.13140/RG.2.2.22558.33602, 2016.

Rodrigue, P., 8.4 – *Urban Transport Challenges | The Geography of Transport Systems. Transport Geography,* Available: https://transportgeography.org/contents/chapter8/urban-transport-challenges/, 2020.

Shen, W., Xiao, W., and Wang, X., *Passenger satisfaction evaluation model for Urban rail transit: A structural equation modeling based on partial least squares*, Available: https://doi.org/10.1016/j.tranpol.2015.10.006, 2016.

Yilmaz, V., and Ari, E., *The effects of service quality, image, and customer satisfaction on customer complaints and loyalty in high-speed rail service in Turkey*: *a proposal of the structural equation model*, *Transpormetrica A: Transport Science* 13, pp. 1-32, 2017.

Biography

Arjay Paul Dequito is a student of the Industrial Engineering Program in the University of Santo Tomas, Manila, Philippines. He graduated Primary Education and Junior High School at Canossa College. Mr. Dequito finished his Senior High School at the San Beda University taking the strand of Science, Technology, Engineering and Mathematics (STEM). He is also a certified Lean Six Sigma Yellow Belt.

Engr. Gabriel C. Bucu is an Instructor at UST Department of Industrial Engineering. He earned his Bachelor of Science in Industrial Engineering at University of Santo Tomas (UST) and his Master of Science in Industrial Engineering at De La Salle University - Manila. He is a Certified Industrial Engineer (CIE) awarded Philippine Institute of Industrial Engineers (PIIE) and an Associate ASEAN Engineer (AAE) awarded by the ASEAN Federation of Engineering Organizations (AFEO). He served as the organization adviser of Operations Research Society of the Philippines – UST Chapter from 2017-2022. His additional research interests include Optimization and Simulation, Design Thinking, and Supply Chain Engineering and Management.

Marcus Jericho Pineda is a student of the Industrial Engineering Program at the University of Santo Tomas, Manila Philippines. He graduated both Junior High School and Senior High School (STEM) also at the University of Santo Tomas, Manila Philippines. He has working experiences as a working student as a previous Junior Digital Marketer, Quality Assurance Analyst, and a n HR assistant/staff.

Ralph Erickson H. Balbin is a student of the Industrial Engineering Program at the University of Santo Tomas, Manila, Philippines. He finished his Primary and Junior High School education at Malabon National High School Special Science Program. He finished his Senior High School at University of Santo Tomas and took the Science, Technology, Engineering and Mathematics (STEM) Strand.

Xinjin Kendrik R. Araos is a student of the Industrial Engineering Program at the University of Santo Tomas, Manila, Philippines. He finished his primary education at Marist School, Marikina, and his Senior High School at the University of Santo Tomas, Manila, Philippines, as a graduate of the Science, Technology, Engineering and Mathematics strand. He is also a certified Lean Six Sigma Yellow Belt.