

Assessing Inland Waterway Service Quality Using SERVQUAL and IPA Analysis

ASHNA SHAJI

Department of Civil Engineering
Rajiv Gandhi Institute of Technology
Kottayam, Kerala, India.

ABHIRAMI P

Department of Civil Engineering
Rajiv Gandhi Institute of Technology
Kottayam, Kerala, India.

AKSA K THOMAS

Department of Civil Engineering
Rajiv Gandhi Institute of
Technology Kottayam, Kerala, India.

AMINA R SHAJI

Department of Civil Engineering
Rajiv Gandhi Institute of Technology
Kottayam, Kerala, India.

GEEVA GEORGE

Department of Civil Engineering
Rajiv Gandhi Institute of Technology
Kottayam, Kerala, India.

Abstract— Inland Water Transport (IWT) is recognized as an energy-efficient and environmentally sustainable mode of transport with significant potential for promoting low-carbon mobility. However, despite Kerala's extensive navigable waterways and policy emphasis on sustainable transport, the modal share of IWT remains limited, highlighting the need to evaluate its service quality. This study assesses the service performance of selected IWT routes in Kerala using a Weighted SERVQUAL framework combined with Importance-Performance Analysis. A total of 408 passenger responses were collected from four representative routes covering urban, semi-urban, and rural contexts. Service Subfactors influencing the performance were identified and performance evaluated across the routes. Study highlights the policy interventions needed to enhance ridership through IPA analysis. The study concludes with identifying and prioritizing the service Subfactors essential to improve passenger satisfaction and encourage a modal shift toward inland water transport in Kerala.

Keywords—Inland Water Transport; SERVQUAL; Importance-Performance Analysis

I. INTRODUCTION

Sustainable transportation is a system that meets present mobility needs while minimizing environmental impacts, conserving resources, ensuring economic viability and social equity, and promoting safe, reliable and low emission travel options [1,2]. Inland water transportation (IWT) is a sustainable transport mode characterized by high energy efficiency [3], reduced external cost (up to 40%) [4], and lower greenhouse gas emission per tonne kilometer than road transport.

IWT aligns with UN's SDGs by promoting inclusive economic growth (SDG 8), resilient and innovative infrastructure (SDG 9), sustainable urban mobility (SDG 11), responsible resource use (SDG 12),

and climate action through lower emissions and cleaner transport technologies (SDG 13) [5]. IWT is integral to India's development vision as it supports national goals of sustainable infrastructure expansion [6], reduced logistic costs [7], multi modal integration [8] and low carbon growth. Thus, IWT is not only vital for efficient and low-carbon mobility but also strongly aligned with the UN's SDGs and India's long-term vision for sustainable, inclusive, and climate-resilient development. In Kerala, IWT has strong potential due to state's extensive waterways of 1895 km of navigable rivers, lakes and canals [10]. However, the modal share of IWT in the state shows a declining trend until 2010, followed by a slight increase in ridership [11].

Studies has shown that passenger's perception on service factors such as safety, comfort, reliability and accessibility can significantly influence modal shift towards water-based transport [12, 13]. Review-based studies and policy-oriented research mainly focus on infrastructure development, governance, and macro-level sustainability benefits of inland waterways [2, 14]. However, these studies largely overlook service quality and passenger experience, which are critical for increasing ridership and achieving modal shift. In the Indian context, research on IWT primarily discusses policy frameworks, historical evolution, and future prospects, with limited empirical evidence based on primary passenger data [1]. There is a noticeable lack of studies that quantitatively evaluate IWT performance from the passenger's perspective, especially those that measure the gap between expectations and perceptions of service quality. Furthermore, although the SERVQUAL model has been extensively applied to railways, bus transport, and aviation to assess service quality [15], its application to inland waterway transport remains very limited. Even fewer studies integrated SERVQUAL with Importance-

Performance Analysis (IPA) to prioritize service improvement areas in IWT systems.

Region-specific studies focusing on Kerala's inland waterway network were particularly scarce, despite the state having one of the most developed IWT systems in the country. Existing literature rarely compares multiple routes across urban, semi-urban, and rural settings, nor does it provide route-specific, actionable recommendations based on systematic service quality evaluation. The objectives of this study are to evaluate the performance of selected IWT routes from the user perspective. The service factors requiring attention have been systematically identified and prioritized to improve the overall performance of IWT through quadrant analysis. The subsequent section of this paper explains the literature review. Methods to evaluate performance of IWT and methods to identify the critical factors were also explained in this section. Section 3 elaborated on the methodology followed in the study. Study area, data collection technique is also explained in the same section. Section 4 described the various analyses conducted in the study followed by the discussions in section 5 and conclusions in section 6.

II. LITERATURE REVIEW

Socio-demographic factors included in this study are age, gender, level of education, income, occupation status as well as ownership of a vehicle [2, 16, 17]. The trip characteristics incorporated in the study include trip purpose, frequency of travel [2, 13, 17]. They affect the choice of travel modes, services efficiency and satisfaction levels. Travel time and trip distance have an influence on the users' sensitivity to reliability and punctuality, while the trip purpose and work schedule have an influence on the expectations in terms of frequency and connectivity.

The five major factors identified from the literatures include infrastructure of vessel and terminal, comfort and convenience, safety and security, connectivity, and attitude of passengers [13, 14]. Comfort and convenience include Subfactors such as availability of seats, cleanliness, and smooth riding experience [12, 16]. Safety and security dimensions identified are safety equipment, surveillance, crew caution, and the vessel's condition [12, 13]. Connectivity factors including feeder transport, terminal access and parking are highlighted in the literatures [18,19]. Behavioural dimensions like value for money, social status, privacy, and travel habits are also found influencing users perception [14,16]. Table below (Table 1) consolidates the factors and subfactors identified from the literatures.

Table 1: Factors and subfactors selected in the present study

Sl. No.	Factors	Sub factors	References
1	Socio demographic	Age, Gender, Education, Income, occupation, Vehicle ownership	2,12,16,17
2	Trip Characteristics	Trip purpose, frequency of travel	2,13,17
3	Infrastructure of vessel and terminal	On time performance, Frequency, Cost, Information and communication, Operational Efficiency of boat and terminal, Vessel amenities	2, 13,14
4	Comfort and Convenience	Availability of seat, cleanliness of boats and terminals, seating comfort, smooth ride	12,13,16
5	Safety and security	Safety equipment inside the boat, crew caution	12,13
6	Connectivity	Feeder transport, ease of access to terminal, parking.	19
7	Attitude of passengers	value of money, social status, privacy, listen to music/ check email/ read newspaper	2

Performance evaluation method was used to understand the relative importance of the identified factors in the proposed framework. Expert opinions were obtained through a structured questionnaire, were the experts rated the importance of each factor based on their knowledge and practical experience. Subsequently, the gathered data was analyzed to get weight values which indicate the importance of the factors in relation to each other.

SERVQUAL was designed to measure service quality by looking at how much gap there is between a customer's expected service and how they actually perceive the service. SERVQUAL was developed by A. Parasuraman, Valarie Zeithaml, and Leonard Berry [15]. SERVQUAL uses five dimensions of service quality to achieve this; (i.e.) Tangibles, Reliability, Responsiveness, Assurance, Empathy [18]. Weighted SERVQUAL is an extension of the basic SERVQUAL framework, where weights are assigned to various service quality dimensions based on their relative importance to customers. It derives a weighted average of the difference between the perceived service (P) and the expected service (E) to arrive at a more realistic measure of service quality [16]. Importance-Performance Analysis (IPA) is a management technique that helps in analyzing service subfactors by comparing the importance of the attribute to customers with the perceived

performance of the attribute. The subfactors are plotted on a Cartesian graph that is divided into four quadrants, with each quadrants representing “Concentrate Here,” “Keep up the Good Work,” “Low Priority,” and “Possible Overkill,” items which can assist organizations in determining where improvements are needed [19].

III.METHODOLOGY

Methodology selected in this study is illustrated in the figure (Fig.1) below.

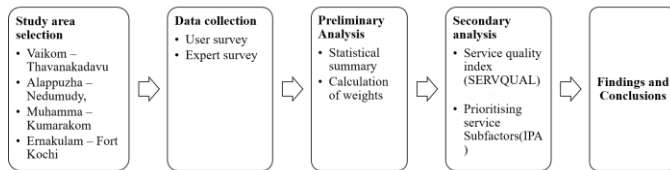


Figure1. Methodology adopted for the study

This study aims to evaluate the performance of selected water transport routes using a structured approach that includes a literature review, data collection, analysis, and reporting. A questionnaire was developed with input from experts and previous studies to assess key service factors such as infrastructure of vessel and terminal, comfort and convenience, safety and security, connectivity and attitude of passengers using a Likert scale. Surveys were conducted starting with a pilot survey to test the questionnaire, followed by a field survey to gather data from potential users. The analysis involved calculating weightages for each factor, creating service quality indices and ranking the routes. An Importance-Performance Analysis (IPA) was also done to identify areas for service improvement.

3.1 Study area

The study was conducted on selected inland waterway routes in Kerala, India, to represent urban, semi-urban, and rural transport conditions: Vaikom-Thavanakadavu, Alappuzha-Nedumudy, Ernakulam-Fort Kochi, Kumarakom-Muhamma were the routes selected. These routes are hereafter represented as R1, R2, R3 and R4 in the paper.

3.2 Data collection method

Primary data for the study were collected through a structured questionnaire survey, designed based on the SERVQUAL framework and previous inland water transport studies. Two separate questionnaires were prepared to collect user responses and expert responses. 5-point Likert scale questionnaire was designed to capture user’s expectations and user’s perception on performance

of inland water transport services. An expert survey (Likert scale responses) was conducted to obtain the importance of each service quality factors. A pilot survey was conducted initially to ensure clarity and reliability of the questions, followed by a detailed field survey across selected inland waterway routes.

User questionnaire had 3 parts. Part 1 collected the sociodemographic and trip characteristics of the responders. Second part has 21 questions which captured Likert responses on perceived service performance across 5 factors namely, infrastructure, comfort and convenience, safety and security, connectivity, and attitude and behavioural aspects. Third part of the questionnaire also had 21 questions and used to collect the expectation of users on the above 5 factors. Expert survey was conducted to understand the importance assigned to each of these factors. Overall, 408 user responses (R1-112, R2-108, R3-107 and R4-81) were collected and each questionnaire took 7-8 minutes. Academicians in transportation engineering field and professionals in inland waterway transport are the experts participated in the expert survey.

IV. ANALYSIS

4.1 Statistical summary of socio demographic factors

The sampling adequacy was checked using Kaiser Meyer Olkin value. KMO value ranged between 0.73 and 0.82 inferring the adequacy of sample size. Reliability of questionnaire was checked using Cronbach alpha. Alpha value obtained was above 0.77 with no improvement on item removal revealing good internal consistency. The socio-demographic analysis of the survey respondents provided an overview of the background characteristics influencing the assessment of IWT performance. The gender distribution is almost equal, with 50.24% male and 49.75% female respondents, indicating a balanced representation. In terms of occupation, the majority of respondents were skilled workers (80.39%), followed by unemployed individuals (13.72%) and professionals (5.88%). The age profile showed that most respondents were above 60 years (53.84%), followed by the 18–60 age group (44.82%), while only 1.32% were below 18 years. Educational status revealed that 39.70% were graduates, 32.84% have education up to Class 10, 25% were postgraduates, and 2.45% were illiterate, indicating a relatively educated sample population. The monthly income distribution showed that 49.75% earned below ₹50,000, 12.50% fall in the ₹50,000–₹1,00,000 range, and only 0.73% earned above ₹1,00,000, while 37% reported no income. Regarding mobility characteristics, 58.82% of respondents do not own a vehicle, whereas 30.88% own a car with license, 9.80% hold a two-wheeler with license, and 0.49% had a bicycle. Travel frequency analysis indicated that 46.56% used the service occasionally,

31.12% used it daily, and 22.30% travelled once every 2–3 days. The purpose of travel was dominated by other personal reasons (60.04%), followed by work-related trips (30.88%), educational purposes (6.61%), and shopping (2.45%). Overall, the socio-demographic profile reflects a diverse and moderately educated population with varied income levels and travel needs, providing a reliable basis for evaluating the performance and user perception of IWT.

4.2 Importance of factors.

The weights of the sub-factors and main factors were calculated based on the responses received from the expert survey. The experts rated the sub-factors on a Likert scale, and the average rating for each sub-factor was calculated. The average ratings were then normalized by dividing the average rating of each sub-factor by the total average of all sub-factors for a particular main factor to get the relative weights. The final normalized weights were the relative weights of each sub-factor to its corresponding main factor. Of all the sub-factors “ease of access to terminal” under connectivity had the highest weight of 0.35, which means it is viewed as the most important sub-factor by the experts. Conversely, “ticket fare” had the least weight 0.15 under infrastructure of vessel and terminal, is the least important sub-factor in the analysis. The findings indicated that although connectivity has the highest weight among all the factors, some sub-factors under comfort and convenience were also found important based on expert assessment. According to expert survey the importance of factors follows the order safety and security (0.21), connectivity (0.21), infrastructure of vessel and terminal (0.20), comfort and convenience (0.20), behaviour (0.16).

4.3 Formulating service quality Index.

To identify the gap between performance and expectations weighted SERVQUAL method was administered. Overall performance of the IWT was calculated as service quality index. SERVQUAL model gives the difference of the performance of the service from the expectation. Here the values of the performance index were negative for all routes, implying the performance was perceived to be below the level of expectation. The more negative the value, the greater the difference between the level of expectation and perception, implying that the service performance is poorer. On the other hand, the less negative value implies a smaller difference, indicating relatively better service performance and greater alignment with the users' expectations. Thus, routes with values close to zero perform relatively better, and routes with highly negative values need improvement. Service quality index across the

four routes were performed and represented in the graph (Fig. 2) below.

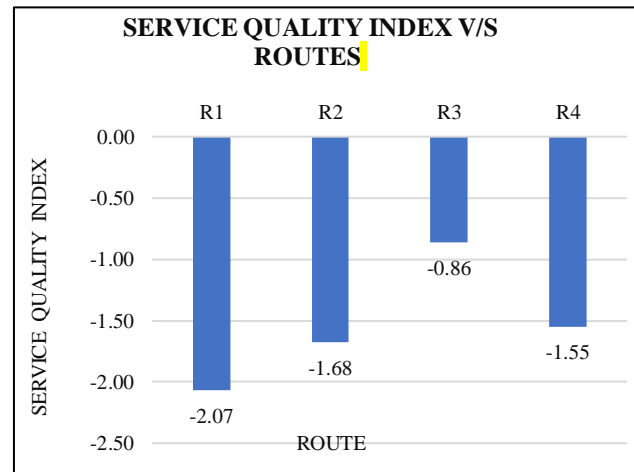


Figure 2. Service Quality Index across Routes

Service quality of each factor is also calculated combining the responses across the routes and presented in figure (Fig.3) below

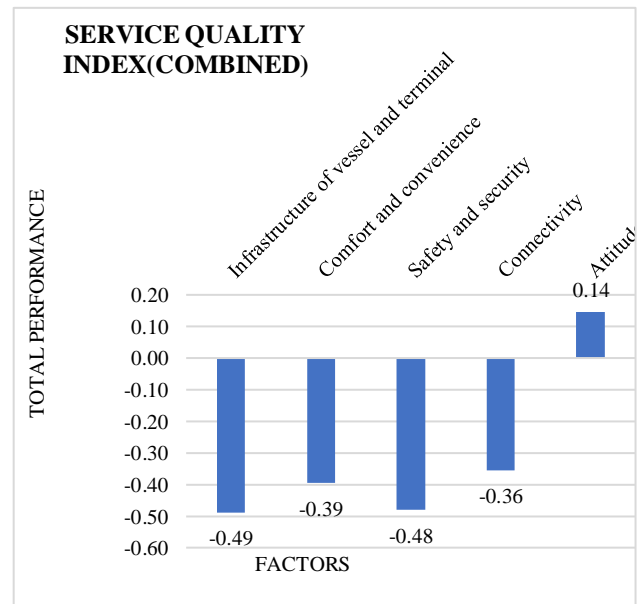


Figure 3. Service Quality Index for Different Service Factors

Route wise analysis of service quality is also performed and is illustrated in the figure 4 to 7 below

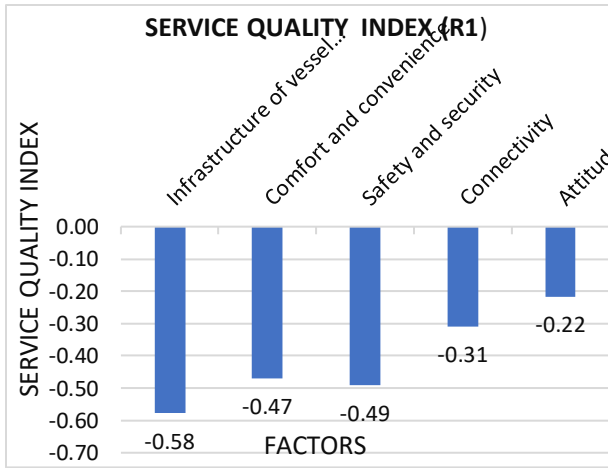


Figure 4 Service Quality Index for Route 1

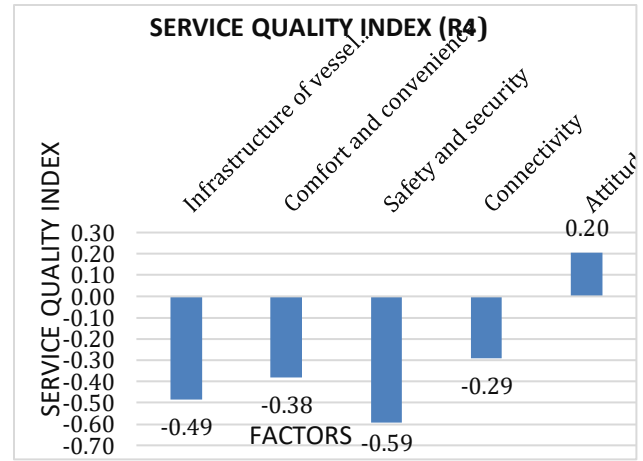


Figure 7: Service Quality Index for Route 4

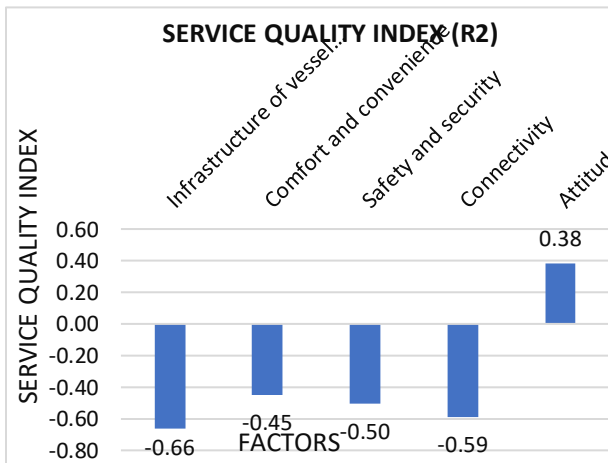


Figure 5 Service Quality Index for Route 2

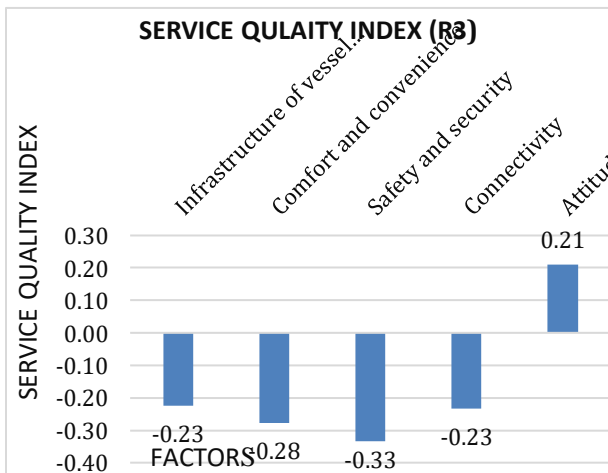


Figure 6: Service Quality Index for Route 3

4.4 Importance performance analysis

Importance-Performance Analysis (IPA) is a strategic assessment tool that can be applied to determine the quality of the service through comparing the perceived importance of the service Subfactors with their performance. It is widely used in service and transport research to identify strengths and weaknesses from the users' perspective. IPA helps decision-makers understand which service Subfactors are performing well and which require immediate managerial attention. By visually presenting results in a two-dimensional grid, it supports effective prioritization of improvements and efficient allocation of resources.

IPA is conducted by first collecting user responses on identified service Subfactors using a Likert scale, typically ranging from 1 to 5, for both importance and performance. The mean importance score and mean performance score were calculated for each attribute. These mean values were then plotted on a two-dimensional graph, where expectation is represented on the horizontal axis and performance on the vertical axis. The graph is divided into four quadrants using reference lines drawn at the overall mean importance and overall mean performance values. Each quadrant has a strategic implication: Quadrant 1 has sub factors with high expectation and high performance and should be maintained. Subfactors with high expectation but low performance required urgent care fall in second quadrant. Subfactors with low expectation and low performance who fall in third quadrant were considered lower priority. Quadrant four represented subfactors with low expectation but high performance may indicate possible over kill. In this study, the value 4,4 was taken as the origin because it represented the mode of score from the user responses. Usage of the mode value as the crosshair ensured that the quadrant classification reflected the actual perception of respondents rather than an arbitrary midpoint of the scale.

Performance Expectation quadrant analysis is given in figure 8. This data-centered approach provides a more realistic interpretation of service strengths and deficiencies within the inland water transport system. The subfactors identified in each quadrant was sorted in the order of importance and given in the table (Table 2) below. The performance gaps of each factors were multiplied with their respective weights to calculate the weighted score. These scores were then arranged in the descending order, with the highest score ranked as 1, indicating the factor requires at most attention. Table 2 below presents the identified factors in each quadrant, listed in order of decreasing priority.

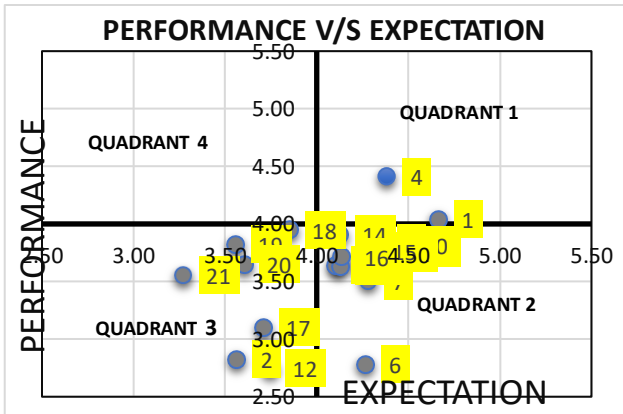


Figure 8. Performance-Expectation Quadrant Analysis

Table 2: Subfactors in each quadrant

Rank.	Sub Factors
Quadrant 1- Keep it up	
1	On time performance (1)
2	Ticket fare (4)
Quadrant 2- Need Urgent care	
1	Vessel amenities (6)
2	Cleanliness of boat and terminal (7)
3	Operational efficiency of boat and terminal (5)
4	Safety equipments inside the boat (10)
5	Crew caution (11)
6	Seating comfort (8)
7	Feeder transport (15)
8	Frequency of boat service (3)
9	Condition of boat (13)
10	Smooth ride (9)
11	Ease access to terminal (16)
12	Behaviour of passengers (14)
Quadrant 3- Low priority	
1	CCTV (12)
2	Real time updates (2)
3	Parking (17)
4	Listening to music (21)
5	Social status (19)
6	Value of money (18)
7	Privacy (20)

V.RESULTS AND DISCUSSIONS

SERVQUAL measures the gap between the performance and expectation of identified factors. The weighted gap is summated to form the service quality index. When the expectation is higher than the performance SERVQUAL will give a negative value. The wider the negative value, the greater the gap between expectation and performance. On comparing total performance of all routes (figure 2), R3 (Ernakulam – Fort Kochi) records the highest overall performance (index value -0.86), reflecting the smallest service gap between comparison highlights that while all locations experience a gap between expected and delivered services, route 3 performs relatively better, whereas route1, Vaikom – Thavanakadavu (index -2.07) requires greater improvement in overall service delivery.

The weighted importance analysis highlights the dominance of infrastructure-related subfactors in determining overall service quality. Infrastructure of vessel and terminal emerged as the most significant factor, whereas attitude of passengers was perceived as comparatively less important.

From the combined performance index graph (Figure 3), the highest performing factor among the five dimensions is behaviour, as it shows the smallest service gap and comparatively better alignment with user expectations. In contrast, infrastructure of vessel and terminal emerges as the least performing factor, indicating the largest gap between expectation and actual performance. Although most factors reflect negative values, suggesting that performance is below expectations, behaviour stands out as the relatively strongest dimension in overall service delivery, while infrastructural aspects require greater attention and improvement.

The performance index of each factor in each route is clearly understood from the graph (figure 4-figure 7). Across the routes, behaviour aspects of users were beyond the expectation, yielding a positive value. Along route 1, all factors were performing less than the expectation with infrastructure of vessel and terminal (-0.58) was identified as the least performing factor, indicating the largest gap between user expectations and actual performance. On the other hand, behaviour aspects of user (0.22) is the highest performing factor, reflecting the smallest service gap among all the dimensions. This shows that while infrastructural aspects require significant improvement, the behavioural aspect is comparatively better along this route. Along the second route also infrastructure of vessel and terminal was the least

performing factor (-0.66) and behaviour aspects of passengers was the highest performing factor (0.44). Along route three and four, safety and security is the least performing factor (-0.33 and -0.59) and behaviour aspect is the highest performing factor (0.21 and 0.20).

IPA analysis was used to identify the gaps between importance and performance of each subfactor rated by the user. These gaps were weighted by multiplying the importance assigned to them from the expert survey. The weighted gaps were then arranged to identify key areas for policy interventions and targeted improvements. The 21 sub-factors were classified into four quadrants based on their relative importance and performance levels (figure 8).

Quadrant 1 (Keep it up) included on-time performance and ticket fare. These factors were perceived as highly important and are currently performing well. This indicated that the service provider is meeting customer expectation in these critical areas and should maintain the current standards to sustain customer satisfaction. Quadrant 2 lists the factors that were considered highly important from user perspective but show relatively low performance. These factors were critical and needed urgent attention. Therefore, they require immediate managerial focus and resource allocation, as improvements in these areas will significantly enhance overall customer satisfaction and service quality. Weighted gaps of these identified critical service quality factors were computed and ranked to prioritize improvement actions. Critical factors identified were vessel amenities, cleanliness of boat and terminal, operational efficiency of the boat, safety equipments inside the boat, crew caution (crew stays vigilant and ensures passenger safety), seating comfort, feeder transport, frequency of boat services, condition of boat, smooth ride, ease of access to the terminal, behaviour of passengers. Quadrant 3 (Low priority) included CCTV, real-time updates, , parking, listening to music, social status, value for money and privacy. These factors were perceived as having lower importance and lower performance. While improvements in these areas may contribute to service enhancement, they were not immediate priorities compared to the factors in Quadrant 2. Quadrant 4 represented highly performing factors which were considered low important by the users. These factors try to overkill the system or represent over allocation of resources. No factors were identified in this quadrant at the selected locations.

Overall, the IPA results suggested that although punctuality and pricing are strong aspects of the service, substantial improvements were required in operational, comfort, safety and accessibility-related factors to improve the overall service experience.

VI. CONCLUSIONS

This study dived into the evaluation and enhancement of Inland Waterway Transport (IWT) in Kerala, aiming to boost service quality and passenger satisfaction. By utilizing the SERVQUAL model along with its modified parameters, the project examines how passengers perceived and expected various service aspects, including comfort, safety, reliability, connectivity, environmental sustainability, and operational efficiency. According to expert survey the importance of factors followed the order safety and security (0.21), connectivity (0.21), infrastructure of vessel and terminal (0.20), comfort and convenience (0.20), behaviour (0.16). Route 3 emerged as the highest performing route among the study locations followed by route 4, route 2 and route 1. Across the routes safety and security, infrastructure of vessel and terminal were identified as the least performing factor. On the other hand, behaviour aspects of user was the highest performing factor. IPA analysis revealed that “on-time performance” and “ticket fare” as highly important and are currently performing well. Among the 21 factors, 12 were identified as needing urgent attention, managerial focus and resource allocation.

Ultimately, this research provided valuable insights for transport planners and policymakers, helping to strengthen IWT infrastructure and encourage a transition towards cleaner, more efficient, and passenger-friendly waterway transport in selected locations.

Acknowledgment

The authors extend the sincere gratitude to the department of civil engineering, R.I.T., Kottayam for providing necessary facilities to carry out the present work.

References

- [1]. Ranjan, R. (2020). Inland water transport in India: Policy evolution and future prospects. *Maritime Affairs*, 16(2), 45–60.
- [2]. Keerthy, S., Ramesh, A., & Nair, V. (2023). Sustainability assessment of inland waterways: A review of policy and performance indicators. *Journal of Transport Geography*, 108, 103548.
- [3]. Bellona Foundation. (2019, March 3). A modal shift: The potential of inland waterways. <https://bellona.org/news/transport/2019-03-a-modal-shift-the-potential-of-inland-water-ways>
- [4]. Hofbauer, F., & Putz, L.-M. (2020). External costs in inland waterway transport: An analysis of external cost categories and calculation methods. *Sustainability*, 12(11), 4563. <https://doi.org/10.3390/su12114563>
- [5]. United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. <https://sdgs.un.org/2030agenda>

- [6]. National Waterways Act, 2016, No. 17, Acts of Parliament, 2016 (India).
- [7]. National Logistics Policy. (2022). National logistics policy 2022. Government of India.
- [8]. Sagarmala Programme. (2015). Sagarmala: Concept and objectives. Ministry of Ports, Shipping and Waterways, Government of India.
- [9]. Paris Agreement. (2015). Paris agreement. United Nations Framework Convention on Climate Change. <https://unfccc.int>
- [10]. Kerala State Planning Board. (2023). Economic review 2023: Transport sector. Government of Kerala. <https://spb.kerala.gov.in>
- [11]. Mereena, C. S., & Prasad, T. K. (2020). Prospects of inland waterways in urban public transport of Kochi city, Kerala. *International Journal of Scientific Research in Engineering and Management*, 6(10).
- [12]. Márquez, L., Cantillo, V., & Arellana, J. (2014). Assessing service quality of public transport systems using user perception and structural equation modeling. *Transport Policy*, 33, 1–12.
- [13]. Tanko, M., Burke, M., & Smith, J. (2019). Modelling public transport satisfaction: The importance of service quality Subfactors. *Transportation Research Part A: Policy and Practice*, 124, 353–368.
- [14]. Bucharest–Danube Canal Study. (2023). Sustainability and economic assessment of the Bucharest–Danube canal project. European Commission
- [15]. Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 64(1), 12–40.
- [16]. Niu, H., Yao, J., Zhao, J., & Wang, J. (2019). Service quality assessment of urban public transport using a weighted SERVQUAL approach. *Sustainability*, 11(19), 5405.
- [17]. Rivera, L., Torres, M., & Delgado, A. (2024). Passenger travel behavior and service quality perception in multimodal transport systems. *Transportation Research Part A*, 175, 103–118.
- [18]. Tileng, K. G., Utomo, H., & Latuperissa, R. (2013). Analysis of service quality using importance performance analysis (IPA) method. *Journal of Industrial Engineering and Management*, 6(1), 24–38.
- [19]. Calderón, R., Gómez, J., & Ruiz, P. (2024). Multimodal connectivity and passenger satisfaction in public transport systems. *Transport Policy*, 145, 55–67.