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Integration of SERVQUAL, IPA, BWM and QFD for Service Quality Improvement in Aviation Fuel Supply Operations

Firgha Ali Pritantyo*, Udisubakti Ciptomulyono
Institut Teknologi Sepuluh Nopember, Indonesia
Email: 6032211009@student.its.ac.id*, udisubakti@ie.its.ac.id

Abstract. This study aims to systematically identify service quality gaps, prioritize customer requirements, and determine actionable technical responses to enhance refueling services at DPPU Juanda. To achieve these objectives, the research employs an integrated and structured framework that combines SERVQUAL to measure service quality dimensions, Importance Performance Analysis (IPA) to identify priority improvement areas, Focus Group Discussion (FGD) to capture in-depth stakeholder insights, Best Worst Method (BWM) to determine the relative importance of technical criteria, and Quality Function Deployment (QFD) to translate customer needs into concrete technical initiatives. The results demonstrate that several technical factors play a decisive role in improving service quality. Effective schedule integration with key stakeholders, the implementation of real-time monitoring systems for refueling operations, and the strengthening of apron audit and control mechanisms emerge as the most critical technical priorities. These initiatives are essential for ensuring service consistency, minimizing operational disruptions, and enhancing transparency and accountability in fuel supply operations. The proposed integrated framework offers a robust decision-support tool for managers by linking customer expectations directly to prioritized technical actions. The study provides practical guidance for improving service reliability, operational efficiency, and customer satisfaction in aviation fuel supply operations, while also offering a methodological reference for similar service quality improvement initiatives in other high-risk and time-sensitive industrial contexts.

Keywords: *Service Quality; SERVQUAL; IPA; BWM; QFD; Aviation Fuel Operations*

INTRODUCTION

Operational reliability and service quality are critical determinants of performance in airport ground operations (Bahas, 2023; Bezerra & Gomes, 2016; Faizal, 2018; Noah, 2025). Aviation fuel supply operations influence turnaround time, on-time departures, safety compliance, and customer satisfaction. Failures in fueling coordination, technical conditions, or communication can cause cascading delays and reduce operational efficiency. As highlighted by Malandri, Mantecchini, and Reis (2019), ground handling and fueling activities form essential components of airport-side operations whose performance directly affects airline service delivery. Therefore, maintaining high-quality service in fueling operations is not only a matter of compliance but a strategic imperative in aviation supply chains (Eyeregba, 2025; Ngoudjou, 2024).

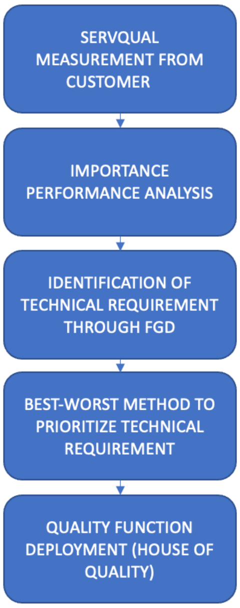
Service quality evaluation in aviation operations often employs structured assessment frameworks to capture gaps between customer expectations and perceived performance. SERVQUAL provides a multidimensional diagnostic tool for identifying these gaps (Parasuraman et al., 1988). Complementing this, Importance–Performance Analysis (IPA) helps prioritize service attributes requiring managerial focus (Martilla & James, 1977). However, understanding customer priorities alone is insufficient for operational improvements; organizations must translate priorities into feasible technical actions. Multi-criteria decision-making (MCDM) methods such as the *Best-Worst Method (BWM) (Rezaei, 2015, 2016) offer rigorous tools for evaluating technical alternatives. QFD then facilitates translation of customer requirements into actionable engineering or operational responses (Mayyas et al., 2011).

Although several studies have combined two or three of these methods, few have integrated SERVQUAL, IPA, BWM, and QFD in a single framework applied to aviation fuel operations. This type of high-reliability, high-coordination environment has been understudied in service quality literature (Hossain & Sarker, 2022). Thus, this study aims to fill this gap by developing an integrated methodology capable of addressing diagnostic, prioritization, and deployment stages of service quality improvement (Saravanan & Rao, 2021). Prior studies have demonstrated the efficacy of using SERVQUAL alongside IPA and QFD to evaluate and enhance service quality in high-complexity environments like aviation fuel operations (Nguyen et al., 2023). Additionally, the Best-Worst Method (BWM) has been successfully integrated with QFD to prioritize customer requirements in various service sectors (Ahmed & Aziz, 2020), but its application in aviation fuel operations remains limited (Kumar & Singh, 2021). As such, combining these four methodologies into a unified framework presents a promising direction for advancing service quality in this critical sector.

The objectives of this study are: (1) to identify service quality gaps using SERVQUAL; (2) to prioritize customer requirements through IPA; (3) to determine technical requirement priorities using BWM; and (4) to translate customer expectations into technical improvement actions using QFD. The study contributes to service quality literature by offering a comprehensive, operationally relevant decision framework and provides practitioners with a structured roadmap for improving aviation fuel services. This paper contributes to both theory and practice by offering a replicable, data-driven framework for aviation fuel service quality improvement and by demonstrating its application in a high-traffic Indonesian airport. The methodology and findings can serve as a basis for continuous improvement efforts in aviation fueling operations across other major airports.

MATERIALS AND METHOD

This study followed a mixed method design combining quantitative customer surveys and expert-based evaluations. The methodological process included five main stages: (1) Service Quality Measurement Using SERVQUAL; (2) IPA for customer requirement prioritization; (3) Expert FGD for technical requirement identification; (4) BWM for determining technical requirement weights; and (5) QFD for translating customer requirement into prioritized technical responses.



Picture 1. Research Methodology

The SERVQUAL approach was employed to measure gaps between customer expectations and perceptions of service quality in aviation fuel refueling services. A structured questionnaire was developed based on five SERVQUAL dimensions and adapted to the operational context of DPPU Juanda. Airline representatives as service users were surveyed to assess expectation and perception scores for each service attribute. The resulting gap analysis enabled identification of service attributes with negative gaps, indicating areas requiring improvement.

Importance Performance Analysis was applied to prioritize customer requirements based on their perceived importance and performance levels. Mean expectation scores were used as importance values, while perception scores represented performance. Service attributes were mapped into the IPA matrix to identify priority attributes requiring immediate managerial attention. Attributes located in the high-importance and low-performance quadrant were selected as critical customer requirements (WHATs) for subsequent analysis.

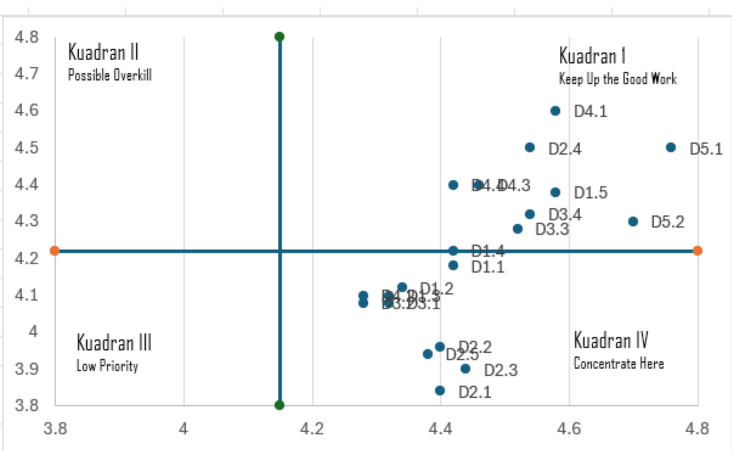
To translate prioritized customer requirements into technical responses, a Focus Group Discussion was conducted involving five domain experts from different functional areas related to aviation fuel operations. The FGD facilitated structured discussions to identify feasible technical requirements capable of addressing customer needs. The use of FGD enabled direct interaction among experts, allowing clarification, consensus-building, and contextual refinement of technical requirements. As a result, a set of eleven independent technical requirements (HOWs) was finalized for further prioritization.

The Best Worst Method was employed to determine the relative importance of the identified technical requirements. Each expert independently selected the most critical (best) and least critical (worst) technical requirement and performed pairwise comparisons using a predefined scale. Individual BWM results were aggregated using an averaging approach to obtain final technical requirement weights. BWM was selected due to its ability to produce consistent results with a limited number of comparisons, making it suitable for expert-based decision environments.

Quality Function Deployment was applied using the first phase of the House of Quality to integrate customer requirements and technical requirements. The relationship matrix between customer requirements (WHATs) and technical requirements (HOWs) was developed based on expert judgment using standardized relationship scores. Roof matrix (technical correlations) and interdependence among customer requirements were excluded, as the study focuses on technical prioritization rather than interaction analysis. Final technical priorities were calculated by combining customer importance weights and BWM-derived technical weights.

RESULTS AND DISCUSSION

The SERVQUAL analysis reveals that all evaluated service attributes exhibit negative gaps, indicating that customer expectations exceed perceived service performance in aviation fuel supply operations at DPPU Juanda. The largest gaps are observed in attributes related to operational reliability, timeliness, coordination, and procedural compliance, highlighting systemic issues beyond individual service encounters. These findings confirm that service quality challenges are primarily process-driven rather than personnel-driven, reinforcing the need for structural and technological interventions.



Picture 2. Quadrant of Importance Performance Analysis

The Importance Performance Analysis further refines these findings by positioning twelve customer requirements within the high-importance and low-performance quadrant. These attributes represent critical service elements that directly influence customer satisfaction and operational continuity, therefore serve as priority customer requirements (WHATs). The dominance of operational and coordination-related attributes in this quadrant emphasizes the importance of integrated scheduling, real-time monitoring, and standardized procedures in aviation fuel services.

Through Focus Group Discussion, these prioritized customer requirements were translated into eleven feasible and independent technical requirements. The expert panel emphasized solutions centered on system integration, digital monitoring, audit reinforcement, and workload management, ensuring that proposed technical responses are actionable within existing regulatory and operational constraints. The use of FGD enabled alignment between customer driven needs and organizational capabilities, reducing the risk of impractical technical recommendations.

The Best Worst Method results indicate that integration of refueling schedules with stakeholders (TR2), real-time refueling process monitoring (TR1), and audit apron systems (TR11) emerge as the highest-priority technical requirements as stated in table 1. These results remain stable across expert assessments, demonstrating strong consensus and robustness. When integrated into the House of Quality, the combined influence of customer importance weights and technical priorities confirms that these three technical requirements provide the highest contribution to overall service quality improvement as shown on table 2.

Table 1. Best Worst Method Weight Aggregate

TR	Technical Requirement	Weight Aggregate
TR2	Integration of Refueling Schedule with Stakeholder	0,17
TR1	Refueling Process Real Time Monitoring System	0,15
TR11	Audit Apron	0,13
TR4	Integration of Fuel Request Information and Payment	0,11
TR10	Workload Arrangement	0,10
TR8	Customer Feedback System	0,09
TR7	Integration of Stock Monitoring System	0,08
TR6	Maintenance Scheduling and Report System	0,06
TR3	Analytical Data to Measure Refueling Effectiveness	0,05
TR9	Role Model Approach	0,03
TR5	Information System of Topping Up Refueler	0,02

Overall, the integrated SERVQUAL–IPA–FGD–BWM–QFD framework successfully transforms customer perceptions into prioritized technical actions. The findings demonstrate that focusing on digital integration, operational transparency, and governance mechanisms offers the greatest potential for improving service quality in aviation fuel supply operations.

Table 2. Technical Requirement

TR Code	Technical Requirement	Priority Rank TR
TR2	Integration of Refueling Schedule with Stakeholder	24,03%
TR1	Refueling Process Real Time Monitoring System	17,93%
TR11	Audit Apron	17,64%
TR10	Workload Arrangement	9,34%
TR4	Integration of Fuel Request Information and Payment	7,47%
TR6	Maintenance Scheduling and Report System	5,17%
TR8	Customer Feedback System	6,31%
TR6	Maintenance Scheduling and Report System	5,17%
TR7	Integration of Stock Monitoring System	3,96%
TR3	Analytical Data to Measure Refueling Effectiveness	3,72%
TR9	Role Model Approach	3,36%
TR5	Information System of Topping Up Refueler	1,06%

Managerial Implications

The findings of this study provide clear managerial direction for improving service quality in aviation fuel supply operations. The prioritization results indicate that management should focus on three strategic initiatives: integrating refueling schedules with stakeholders, implementing real-time refueling process monitoring, and strengthening apron audit systems. These initiatives address the most critical customer expectations while simultaneously enhancing operational control, transparency, and regulatory compliance.

To ensure effective execution, management should establish a cross-functional task force responsible for planning, implementation, and performance monitoring of the prioritized technical requirements. This task force should conduct gap analyses against existing programs, evaluate investment feasibility through structured cost–benefit considerations, and develop implementation roadmaps supported by measurable Key Performance Indicators (KPIs).

Furthermore, stakeholder engagement through targeted socialization and workshops is essential to align internal units and external partners, ensuring that service improvements are institutionalized rather than project based. Overall, the proposed framework enables managers to systematically translate customer needs into executable technical actions, supporting evidence-based decision-making and continuous service quality improvement in complex, multi-stakeholder aviation operations.

CONCLUSION

This study introduces an integrated SERVQUAL–IPA–FGD–BWM–QFD framework to systematically enhance service quality in aviation fuel supply operations, bridging customer expectations—measured via SERVQUAL and IPA—with expert-driven prioritization and deployment through FGD, BWM, and QFD. Applied empirically at DPPU Juanda, it identifies key technical priorities like integrating refueling schedules with stakeholders, real-time monitoring, and stronger apron audits to boost reliability. Theoretically, it advances service quality and operations management literature by extending gap analysis to actionable prioritization in high-reliability, multi-stakeholder contexts. Practically, it equips managers with a replicable, evidence-based tool for complex aviation decisions, transferable to other industries. For future research, incorporating dynamic performance metrics, modeling interdependencies among technical requirements, or conducting multi-airport comparisons could further validate and refine the framework's robustness.

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