

DOI: <https://doi.org/10.38035/jmpis.v7i6><https://creativecommons.org/licenses/by/4.0/>

Received: 01 Oktober 2026 | Revised: 07 Oktober 2026 | Accepted: 19 Oktober 2026

Customer Satisfaction and Quality of Energy Port Management Technical Services: A Case Study in *the Marine Operation Area of Sulawesi*

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Abstract: Port management technical services underpin national energy distribution, yet energy terminals in the Sulawesi Marine Operation Area still face problems of personnel competence, limited safety inspectors, oil spill preparedness, and vessel waiting time. Previous studies tend to examine a single service aspect or port and rarely link them to customer satisfaction. This study evaluates the technical service quality of PT Pertamina Port and Logistics across four pillars, namely mooring and unmooring, the ship shore safety checklist, oil spill response, and pilotage and towage, while analyzing customer satisfaction through five service quality dimensions. A multiple qualitative case study was conducted at five terminals, namely Makassar, Baubau, Bitung, Gorontalo, and Raha, using 25 purposively selected data sources gathered through interviews, observation, focus group discussions, and documents, and analyzed with NVivo software. The findings show that no terminal has personnel holding mooring operation certification, oil spill response is the strongest pillar, inspector workload exceeds optimal capacity at the three large terminals, and the largest waiting time arises in pilotage. The novelty lies in revealing a paradox of positive customer satisfaction resting on a fragile formal competence foundation, together with 14 best practices and solutions contextual to port class.

Keywords: Customer Satisfaction, Technical Service Quality, Port Management, SERVQUAL, Energy Terminal

Abstrak: Port management technical services support national energy distribution, but energy terminals in the Sulawesi Marine Operation Area still face problems with personnel competence, limited safety inspectors, oil spill preparedness, and ship waiting times. Previous research tends to examine one aspect of service or one port and rarely associates it with customer satisfaction. This study aims to evaluate the quality of PT Pertamina Port and

Logistics' technical services on four pillars, namely ship docking, ship-land safety checklist, oil spill management, and ship guidance and delay, as well as analyzing customer satisfaction based on five dimensions of service quality. The method used was a compound qualitative case study in five terminals, namely Makassar, Baubau, Bitung, Gorontalo, and Raha, with 25 data sources purposively selected through interviews, observations, focus group discussions, and documents, then analyzed with NVivo software. The results showed that none of the terminals had certified personnel for dock-and-release operation, oil spill control being the strongest pillar, inspector workload exceeding optimal capacity in the three major terminals, and the largest waiting time occurred in guidance. The novelty of this study is the finding of a positive customer satisfaction paradox on the fragile foundation of formal competencies and 14 best practices with contextual solutions according to port class.

Kata Kunci: *Customer Satisfaction, Quality of Technical Services, Port Management, Servqual, Energy Terminals*

INTRODUCTION

Energy ports play a strategic role in maintaining national energy security because they are nodes for the distribution of oil and gas fuel between regions. This role is carried out, among others, by PT Pertamina Port and Logistics (PT PPL) which manages port technical services in the Sulawesi *Marine Operation Area* with 17 ports (Maemunah, Bayu, et al., 2023; Maemunah, Damanik, et al., 2023). Oil and industrial ports have different operational characteristics than public ports (Russo & Musolino, 2023), and the quality of port services is closely related to service user satisfaction (Le et al., 2020; Phan et al., 2021). Therefore, technical services at energy terminals are not enough to be judged from the smooth operation, but also from the competence of personnel, safety, and environmental preparedness (Maemunah, Batista, et al., 2023; Maemunah & Marta Anggoro, 2022).

Initial observations show four pillars of vulnerable technical services. First, *mooring-unmooring* is carried out by 158 *mooring gang* officers who do not yet hold *mooring operator certification*, even though the mooring failure is related to the condition of the rope and the competence of the implementer (Prasetyo et al., 2023) and the competence of personnel determining work safety at the port (Jin et al., 2021; Lopes et al., 2025). Second, the implementation of the *Ship Shore Safety Checklist* (SSSCL) depends on the *Marine Terminal Safety Inspector* (MTSI), while each location has only one MTSI and the workload of safety inspectors affects the achievement of maritime safety (Setiawan et al., 2025). Third, *Oil Spill Response* (OSR) preparedness requires the integration of procedures, personnel, and equipment (Ishak et al., 2020), but the *Oil Spill Contingency Plan* (OSCP) document is not yet available or updated evenly. Fourth, ship guidance and delay services create wait times that reduce operational efficiency (Maulana et al., 2020; Putra & Sahara, 2023) and can be reduced through better information exchange (Nikghadam et al., 2023).

Previous research has generally examined one aspect or one location. Afrianti et al. (2025) examined safety procedures at one fuel terminal, Jadda et al. (2022) reviewed external supervision of oil spill management in Parepare, and Putra and Sahara (2023) analyzed the waiting time factor without linking it to overall customer satisfaction. The SERVQUAL model has been used in guidance and delay services (Basara et al., 2022; Wijaya, 2022), but not on all four pillars of technical services at once. Alzbutas et al. (2021) also emphasized that there is still a rarity of studies that assess oil terminals in their entirety. Thus, there is a *research gap* in the absence of an integrated evaluation that connects the four pillars of technical services with customer satisfaction perceptions at several energy terminals with different port classes. The *novelty* of this research lies in the cross-location multiple-location case study approach

that combines interviews, observations, focus group discussions, and operational data, and produces a map of best practices and contextual recommendations according to port class (Maemunah, Bayu, et al., 2023; Maemunah & Trisakti, 2025).

This study answers five questions, namely: 1. how the condition of ship docking and offloading services is related to the competence of officers and supporting facilities; 2. how is the effectiveness of safety supervision through SSSCL in the midst of MTSI limitations; 3. how is the readiness to deal with oil spills; 4. how to implement ship guidance and delays, especially waiting times; and 5. how is the perception of customer satisfaction with the overall technical services. The purpose of this study is to evaluate the quality of PT PPL's technical services on the four pillars and analyze customer satisfaction based on the SERVQUAL dimension to formulate improvement priorities.

METHODS

This study uses a descriptive qualitative approach with a compound case study design because technical services and customer perceptions need to be explored contextually and compared between locations (Creswell & Poth, 2018). The object of the research is PT PPL in *the Marine Operation Area* of Sulawesi. Five locations were selected purposively based on the classification of port scale, namely large class (Makassar, Baubau, and Bitung), medium class (Gorontalo), and small class (Raha). The research will be carried out in 2025–2026 with operational data in 2025.

Primary data was obtained from 25 data sources that were purposively selected based on direct involvement and depth of knowledge, namely port managers and supervisors, MTSI, *mooring alleys* and OSR personnel, terminal representatives, captains and crew, syahbandar, guides, and a port management expert. Data collection was carried out through in-depth interviews whose guidelines were compiled from research questions and SERVQUAL dimensions, direct observations at the dock, and focus group discussions. Secondary data included operational reports on the IPMAN application in 2025, a recapitulation of OSR personnel and equipment certification, OSCP documents, and internal procedures and port regulations (Maemunah et al., 2021).

Data analysis used the interactive model of Miles and Huberman (2013), namely data condensation, data presentation, and conclusion retrieval and verification, with the help of NVivo software for cross-location coding and *matrix* coding (Wahid et al., 2023). The quality of service was assessed through five dimensions of SERVQUAL (Parasuraman et al., 1988), namely *reliability*, *assurance*, tangible evidence, *empathy*, and responsiveness. The validity of the data is maintained through triangulation of sources, techniques, and theories as well as *member checking*. Since the principal investigators are also practitioners in the companies studied, the perspectives of regulators and experts are used to reduce subjectivity bias (Maemunah et al., 2022; Tanasale et al., 2023).

RESULTS AND DISCUSSION

Results are presented according to four pillars of technical service, followed by customer satisfaction, best practices, and cross-site themes.

Ship's back-off pillars

The docking-and-release procedures at all five locations followed the company's internal procedures, beginning with a brief safety meeting before the operation and communication between the ship, guides, and ground officers. Customers rated it positive at all locations and there were no fatalities. The risks most often mentioned by the implementers were sudden weather changes, loosening of mooring ropes, and falling officers from rubber boats; in Gorontalo, a near-fall incident in 2022 prompted the implementation of safety meetings in every operation.

The most critical finding was cross-site: none of the *mooring gang* personnel in Makassar, Baubau, Bitung, Gorontalo, or Raha held a valid *mooring operation* certification. This condition is recognized by field implementers, focus group discussion forums, and regulators (Maemunah & Endri, 2025). Experts consider it to increase the potential for lea-on failure and harbor legal risks to special terminal operating permits (Maemunah et al., 2026). Good service quality therefore relies on experience and intergenerational knowledge transfer, not on verified competence. This pattern is fragile, as shown by the mooring rope failure study (Prasetyo et al., 2023) and the safety competency study of port operators (Jin et al., 2021).

Ship-onshore safety checklist pillar

SSSCL is carried out uniformly at all locations according to international guidelines (International Chamber of Shipping & Oil Companies International Marine Forum, 2020), starting with an opening meeting and a point-by-item inspection between MTSI and ship representatives. The most common findings are damaged ship equipment or oil spills around the *manifold*, and findings are recorded and followed up through the company's reporting application. MTSI emphasizes that one hundred percent compliance on each item is unrealistic because the condition of each ship is different, while the authorities did not find major findings in its inspections.

However, Table 1 shows that each location has only one MTSI without formal reserves, so the ratio of ship visits per MTSI reaches 81.2 per month in Baubau, 43.0 in Bitung, and 41.1 in Makassar, well above Gorontalo (8.3) and Raha (4.1). In congested locations, MTSI is assisted by operational support personnel and *mooring alleys*, but MTSI itself admits that supervision is less than optimal.

Table 1. Marine Terminal Safety Inspector Workload by Location in 2025

Lokasi	Quantity MTSI	Total ship visits	Average per month	Status
Baubau	1	974	81,2	Not optimal
Makassar	1	493	41,1	Not optimal
Bitung	1	516	43,0	Not optimal
Gorontalo	1	100	8,3	Optimal
Raha	1	49	4,1	Optimal

The effectiveness of SSSCL in the three major terminals therefore reflects more on the diligence of individual MTSI than the adequacy of work capacity. This finding is in line with the study of Setiawan et al. (2025) that inspector workload affects maritime safety achievements, and is a structural vulnerability that needs to be addressed first.

Oil spill mitigation pillar

This pillar is the strongest. Exercises are conducted every three months at all locations, customers express high confidence in the team, and IMO standard personnel certifications are met at four of the five locations (Table 2). Raha is the only location that has not met the minimum requirements (3-0-0 to 6-1-1). Damaged equipment in Baubau, Makassar, and Gorontalo, including a 1989 oil boom and a 1990 *oil skimmer*, already have replacement units. An interesting practice was found in Gorontalo, where *mooring* officers are also OSR personnel so that their knowledge of local waters improves readiness.

There are two critical notes. First, the Baubau and Makassar OSCPs were last assessed in 2018 so that they fell behind from the development of the terminal, even though a readiness reassessment needs to be carried out every time there is a change in facilities in accordance with the Regulation of the Minister of Transportation Number PM 58 of 2013 (Minister of Transportation of the Republic of Indonesia, 2013). Second, in Gorontalo, the movement of spills is dominated by river currents so that the management strategy is different from open

waters. These results confirm that preparedness requires the integration of procedures, personnel, and equipment (Ishak et al., 2020).

Table 2. Oil Spill Preparedness by Location

Location	Certifications IMO (Level I-II-III)	Good/total equipment	Year OSCP	Certification status
Baubau	24-2-2	22/26	2018	Fulfilled
Makassar	18-3-4	15/16	2018	Fulfilled
Bitung	16-2-2	17/17	Terbaru	Fulfilled
Gorontalo	9-1-1	11/15	2025	Fulfilled
Raha	3-0-0	12/12	2025	Not fulfilled

Pillars of ship guidance and delay

Table 3 shows a total waiting time of 321 hours and 53 minutes in 2025 with a very different pattern between locations. Bitung recorded the highest waiting time (159 hours and 30 minutes), dominated by a guide waiting time of 144 hours that appeared every month so that it was structural, not incidental. The cause was the division of the guiding business entity with the public port and the availability of only one guide on duty. Baubau still recorded 92 hours and 42 minutes even though it had two special tugboats, due to a sudden change in the ship's schedule. In Raha, the waiting time occurred because a number of skippers refused to dock at night due to the absence of guides and tugboats that were not required in the waters.

Table 3. Ship Waiting Time per Location in 2025 (hours:minutes)

Location	Waiting for a drive	Waiting for a delay	Waiting for the light	Total
Baubau	82:30	10:12	–	92:42
Makassar	27:48	–	–	27:48
Bitung	144:00	15:30	–	159:30
Gorontalo	03:29	–	–	03:29
Raha	–	–	38:24	38:24
Total	257:47	25:42	38:24	321:53

Skipper and guide information exchange procedures before maneuvering are carried out at all mandatory guide locations, and waiting time monitoring is carried out through the company's digital application. These results are in line with studies of waiting times at other ports that place the availability of support and coordination services as the main factor (Maulana et al., 2020; Putra & Sahara, 2023), as well as with the role of tugboats in port navigation safety (Paulauskas et al., 2021). Guiding safety in narrow channels is also influenced by human factors (Prastyasari et al., 2025), which is relevant for the Bone River channel in Gorontalo.

Customer satisfaction based on SERVQUAL dimensions

Customer perception of all technical services has a positive value, but with a different profile in each dimension (Table 5). The relationship between the dimensions of service quality and satisfaction with guidance and delay services was also found by Basara et al. (2022) and Wijaya (2022). The assurance dimension shows the widest spectrum, namely the highest in oil spill management and safety inspections, but lowest in back-and-forth. This is the main paradox of this study: customers feel assured because there has never been a major incident, while the basis for formal assurance in the form of competency certification does not exist. Trust like this can easily collapse if there is a serious incident (Firmansyah & Maemunah, 2021; Yuliantini & Maemunah, 2023).

The physical evidence dimension tends to be better in the larger port class, in line with the role of facilities in port user satisfaction (Najwan et al., 2024), although Raha shows

improvement after the 2024–2025 port revitalization. The empathy dimension is most equitable and highest in small locations through personalized services. The responsiveness dimension shows a two-level pattern, namely high on reactive response in the field but weak on proactive initiatives and hampered by structural constraints of guidance and delays. The most frequent complaints arise not on the four pillars, but on the supply of fresh water to vessels that are often not in demand due to limited stock. Customers submit complaints through service level agreements and reporting applications, which are followed up with root cause verification.

Table 4. Synthesis of Cross-Site SERVQUAL Dimension Assessment

Dimensions	Cross-site findings profile
Reliability	High on procedural levels across locations; vulnerable to formal competence and inspector workload.
Warranty	Highest on oil spill prevention and safety inspections; lowest on back-and-forth without certification.
Physical evidence	Good in Baubau; enough in other locations; Gorontalo and Raha adapt innovatively.
Empathy	Tallest and most even; highest in small locations.
Responsiveness	Two levels: high reactive, weak proactive, and constrained drive-thru waiting time.

Port class profiles, best practices, and cross-site themes

The problem profile differs according to the port class. Large classes face volume pressures: Baubau with the paradox of guide waiting times in the middle of a special fleet, Makassar with the complexity of eight types of fuel and changes in the corporate structure, and Bitung with the highest guide waiting times. Gorontalo, as a medium class, faces permanent geographical obstacles in the form of river channels and the absence of tugboats, but records the lowest waiting times among mandatory guide locations and very high satisfaction. Raha, as a small class, is limited in resources but benefits from the proximity of work that allows for personalized service.

The cross-site analysis yielded 14 best practices and five themes. Twelve practices were universal and two were contextual, namely the specific guidance business entity per terminal for Makassar and Bitung and the circling of ships with *oil booms* for high-current locations. The most urgent practices to be standardized were safety meetings prior to *mooring operations* from Gorontalo, scanning of ship conditions and classification of SSSCL findings from Raha, joint exercises with terminals from Baubau and Raha, skipper-guide information exchange prior to maneuvers from Baubau, and weekly OSR engine maintenance from Bitung. The exchange of information is in line with the importance of a shared frame of reference between guides and skippers (Chauvin et al., 2022). Interestingly, the most productive innovations are actually born in locations with the greatest limitations.

The five cross-site themes are: 1. the absence of *mooring certification* across locations; 2. discipline that is situational, strict during operation and loosening during standby, which is in line with the role of human factors (Hasanspahić et al., 2021) and work discipline (Labi et al., 2024); 3. Unique problem profiles of each site class; 4. Solutions that must be contextual per site class; and 5. Dualism of internal barriers, such as competence, inspector ratios, and procedure updates, as well as external barriers, such as weather and the structure of the guiding business entity. Internal barriers are within the company's control so they need to be prioritized.

These findings have implications on three levels. At the corporate level, competency certification, particularly *mooring operations* and OSR, need to be an annual budget priority, and uniform resource allocation per site needs to be replaced with a weighted formula that takes into account operation volume, geographic complexity, and risk level. At the industry level, the SERVQUAL framework combined with NVivo-assisted compound case studies can be adopted by other energy terminal operators, so that evaluations don't just rely on wait times. At the regulatory level, the verification of the certification of *mooring gang personnel* in routine

inspections needs to be strengthened, OSCP updates need to be triggered by significant changes in terminal infrastructure, and the condition of Raha without guidance obligations and without tugboats needs to be evaluated in terms of navigation safety (Maemunah et al., 2024).

There are three new findings of this study. First, the paradox of high customer satisfaction on top of weak formal competence, which is not revealed by previous lead time or per-pillar studies. Second, the problem profile is determined by the port class so that a uniform solution is not appropriate. Third, a map of 14 best practices that are sourced from large to small locations and can be replicated.

CONCLUSIONS AND SUGGESTIONS

Conclusion

The study concluded that PT PPL has maintained customer satisfaction at a positive level in Sulawesi's five energy terminals, but the quality of its technical services rests on a risky foundation, especially on personnel competence and procedural updating. In the stand-off pillar, none of the terminals have *mooring operation certified personnel*, so good service has not been supported by verified competence. In the safety pillar, SSSCL is running effectively without major findings, but the ratio of one MTSI to 81.2 vessel visits per month in Baubau exceeds the optimal threshold and becomes a structural vulnerability.

In the oil spill mitigation pillar, readiness is generally adequate, with a record certification deficit in Raha and OSCP Baubau and Makassar lagging behind since 2018. In the guidance and delay pillars, waiting times vary by port class: the largest in Bitung due to co-guiding business entities, remains high in Baubau despite having a dedicated tugboat, and is daytime in Raha. From the customer side, the dimensions of assurance and empathy are strengths, while reliability, consistency, competence and proactive responsiveness still need to be improved. As problem profiles differ by port class, improvements need to be designed contextually, not uniformly.

Limitations

This study has several limitations. First, it covers only five of the 17 locations in one operating unit and one data period, so the results cannot be generalized to other operators or regions. Second, the qualitative approach does not measure satisfaction quantitatively or the economic impact of competency gaps. Third, the waiting time data only contains time above the company's standard tolerance, and the main researcher who is also a practitioner has the potential to cause bias, even though it has been controlled through triangulation and *member checking*.

Suggestions

For PT PPL, it is recommended to develop a scheduled *mooring operation* certification program at all locations within six months, increase the MTSI to a minimum of four people in large locations, and update the OSCP and conduct a reassessment in Baubau and Makassar. In the medium term, universal best practices can be standardized, while in the long term, it is necessary to review specific guidance business entities for Makassar and Bitung, night-docking access in Raha, and dredging and channel monitoring in Gorontalo.

For further research, it is recommended to expand the scope of locations and operators, use mixed methods to measure satisfaction and economic impact of competency gaps, and use longitudinal or modeling approaches such as *Structural Equation Modeling* and *System Dynamics* to test the relationships between pillars.

Acknowledgment

The author would like to thank the leadership of the Trisakti Institute of Transportation and Logistics, all informants and colleagues of Marine Operation Sulawesi and Marine Baubau PT Pertamina Port and Logistics for providing data and support during the research.

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