Analysis and Evaluation of Service Quality using Integration of Servqual, Kano Model and QFD (Case Study : Pacitan Coal Fired Power Plant)

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Abstract. Pacitan Coal Fired Power Plant (CFPP) is one of the power plants owned by PT PLN (Persero) whose operation and maintenance are managed by PT PJB with an asset management contract scheme. The achievement of the service level agreement (SLA) of Pacitan CFPP is the lowest in the period 2018 to 2021. For this reason, this study takes the object of improving the quality of operation and maintenance services at Pacitan CFPP in the hope that it can become a reference framework for improving the quality of operation and maintenance services. This study uses the integration of the Service Quality, Kano Model, and Quality Function Deployment (QFD) methods which provide advantages that cannot be obtained if each method is used individually. Integrating Servqual with the Kano Model makes service attribute prioritization better. Meanwhile, the integration of the two models with QFD makes quality improvement program planning more systematic. The results of the study show that all quality attributes have a negative gap. This indicates that the operation and maintenance services of the Pacitan CFPP are still not good, where the largest number of gaps is in the Responsiveness dimensions. From the results of classifying service attributes using the Kano Model, it is known that there are 25 service attributes that fall into the important category, where 3 attributes fall into the M category (must-be), 20 attributes fall into the O (One Dimensional) category and 2 attributes fall into the A (Attractive) category. Furthermore, by using the House of Quality and Pareto Analysis, it is recommended to PT PJB Management to focus on 10 out of 16 Technical Responses as improvement programs to upgrade O&M service quality and SLA achievement as well as customer satisfaction of the Pacitan CFPP.
Keywords: Operation and Maintenance Service, Servqual, Model Kano, Quality Function Deployment (QFD)

12. Introduction

PT PJB's main products are electricity and operational readiness, where currently revenue from selling electricity reaches ±85% of PT PJB's total business revenue. However, based on historical and projected data, sales of PJB's electricity as the main source of revenue have experienced a downward trend. To maintain revenue growth and business sustainability, PT PJB is developing several business line other than electricity which is expected to become a new source of income for PT PJB, one of them is Operation and Maintenance (O&M) Services of power plant. O&M services has become PT PJB's second largest source of income after electricity and the potential revenue growth of this business line is also promising. In accordance to the 2021 - 2030 Electricity Supply Business Plan (RUPTL), there will be an additional 40.6 gigawatt (GW) power plants in Indonesia. Of this amount, PLN's portion is 14,269 GW or around 35.2%, while the remaining 26,006 GW or 64.8% is the portion of Independent Power Producers (IPP). Currently PT PJB has O&M Service contracts with PT PLN (Persero) for several

power plants in the PLN regional area, one of them is Pacitan coal fired power plant (CFPP) which the achievement of service level agreement (SLA) is the lowest from 2018 to 2021, therefore the problem definition of this study is how to improve the quality of O&M services at Pacitan CFPP in order to increase the achievement of SLA and customer satisfaction. The study aims to identifiy quality attributes of O&M services according to Pacitan CFPP's customer, to rate the quality attribute that will become a focus of service quality and customer satisfaction improvement and to give recommendation of improvement programs to PT PJB in order to upgrade O&M service quality and SLA achievement as well as customer satisfaction.

In a global and highly competitive market, it is essential for the survival of any firm involved in the service industry to be adaptive, responsive to changes, proactive, and can deliver high-quality products according to diverse customer requirements [1]. Failure to capture customers' factors and technical specifications significantly affect all business processes in a company [2]. Many studies suggest that service quality and customer satisfaction are key factors of the service industry [3] Service quality is a key factor that leads to higher customer satisfaction, higher intention to visit and greater profitability [4]. Therefore, businesses have to strive to provide high-quality services because it is a basic strategy to survive and succeed in a competitive market [5].

Several tools, methods, and techniques have been used to assess the service requirements and quality. Servqual is one of the most widely used quality tools for measuring service quality [3] by capturing the customer's perceptions and expectations of the service dimensions [6]. Servqual dimension can be used to identifiy quality attributes of O&M services according to Pacitan CFPP's customer, but despite its importance, Servqual does not contribute to the precise identification of the critical quality attributes according to customer's perceptions [7]. This limitation can be reached with the integration of Servqual with other quality tools [8,9]. Kano model can describe that customer expectations and experiences could be grouped into several categories that each has a different impact on customer satisfaction [10]. Kano model can be used to define quality attribute of O&M services that will become a focus of service quality and customer satisfaction improvement by PT PJB according to Kano categories.

By knowing the category of service attributes that provide a big impact on customer satisfaction we could design important service characteristics to fulfill the need with the use of the *Quality Function Deployment* (QFD) method. QFD is a powerful methodology that can translate customer need to technical response requirements to ensure that output, either product or process, will fulfill the need [11]. The advantages of QFD implementation are it could raise organization effectiveness, and cost efficiency as well as enhancement of customer and employee satisfaction [12]. Furthermore, in the service design process, Quality Function Deployment (QFD) aims to select the service characteristics that are essential to meet customer requirements ensuring that the voice of the customer (VoC) is captured [13]. QFD provides a better understanding of VoC and deploys it into a set of appropriate technical and process service requirements, complementing Servqual and Kano [13]. QFD can be used to generate and prioritize improvement programs to PT PJB in order to upgrade O&M service quality and SLA achievement as well as customer satisfaction. These combined benefits could not be achieved through the use of each quality tool individually, integration of Servqual, Kano models, and QFD can be used to improve design and quality of service [14]

13. Methods

The methodology used in this study consisting of data collecting stage, data processing stage and analysis and conclusion stage. The methodology used in this study described in Figure 1.

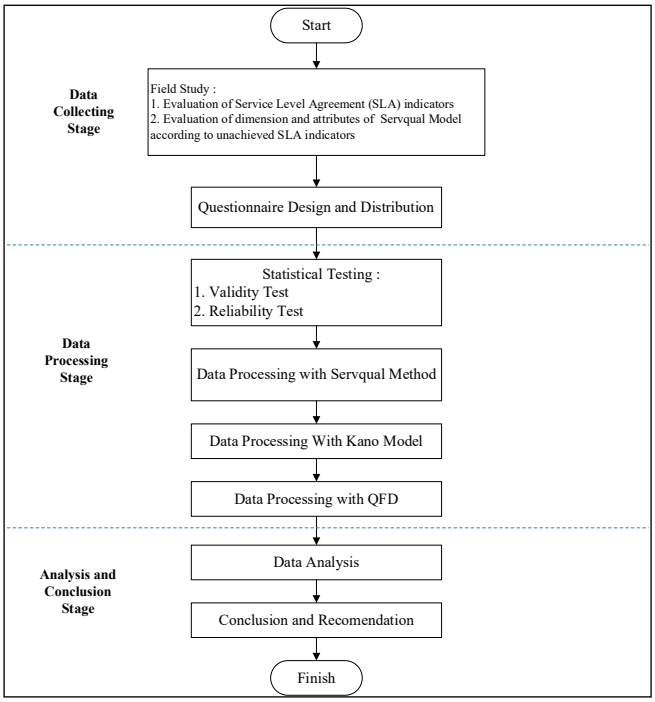

Figure 1. Research Methods

Data Collecting Stage

At the data collection stage, an evaluation of the achievement of the Pacitan CFPP SLA was carried out, by collecting data on the achievement of the Pacitan CFPP SLA and identifying SLA indicators that were not achieved. Furthermore, based on the SLA indicators that were not achieved, brainstorming was carried out with PT PJB Management Team stakeholders of the O&M services, to map the unachieved indicators into quality attributes using the Servqual dimension (Tangibility, Reliability, Responsiveness, Assurance, Emphathy) as material to prepare the Servqual and Kano questionnaires. Furthermore, as O&M services is a business-to-business service, the questionnaires were distributed to the persons in charge representing the customer institutions of the Pacitan CFPP as many as 30 people as the target respondents to the questionnaire. Pacitan CFPP customer institutions are PT. PLN UP2B Central Java, PT. PLN UP2B East Java and PT. PLN Generation and EBT Division for Java, Madura and Bali Regions.

Data Processing Stage

The statistical tests carried out included validity and reliability tests of the data from the collected questionnaires. Validity and reliability tests were carried out using SPSS 22. The test is said to be valid if the results of r count > r table and will also be said to be reliable if *Cronbach Alpha* > r table.

Data Processing using the Servqual Method

Data processing is done by calculating the average value of consumer perceptions and expectations as well as the average importance value of each quality attribute. Gap score is calculated by comparing perception and expectation scores. The satisfaction score is calculated by multiplying the gap with the importance value of each quality attributes.

Data Processing using the Kano Model

Data processing with Kano Model includes the following steps:

1. The answers obtained from respondents about functional and disfunctional quality attributes were classified for each question and then tabulated into the Kano Model evaluation table category.
2. Determination of the Kano category for each attribute is carried out using the Blauth Formula i.e. adding up each one category, if (M+O+A) > (R+I+Q) then the selected category is the most maximum of (M+O+A), but if (M+O+A) < (R+I+Q) then the category chosen is the maximum of (R+I+Q)

Data Processing using QFD

Data processing with the Quality Function Deployment (QFD) method was carried out with the integration of the Servqual method and Kano Model into the House Of Quality (HOQ). Integration of Servqual, Kano Model, and QFD cariied out by calculating Adjusted Importance to Customer from the Satisfaction Score of Servqual multiplied by Kano Model category weight (Attractive = 4, One dimensional = 2, Must be = 1). Ranking of quality attributes carried out by multiplying Adjusted Importance to Customer with Improvement Ratio and Sales Poin.

Furthermore, technical responses for each attribute are identified by brainstorming with the PT PJB Management Team stakeholders of the O&M services. Inter-Relationship Matrix is developed by identifying the correlation between each technical responses and quality attributes (strong = 9, moderate 3, weak =1). Meanwhile the correlation between each technical responses are carried out to build Technical Correlation Matrix. Prioritization of the technical response is obtained by multiplying normalized raw weight of Planning Matrix with numeric weight of Inter-Relationship Matrix. This order is the priority order of improvement program of Pacitan CFPP O&M service.

Analysis and Conclusion stage

At this this stage the analysis and interpretation of data processing results which produce priority attributes that are the focus of improvement as well as recommendations for improvement programs according to research objectives will be carried out.

14. Result and Discussion

This section will discuss about the finding and limitations of this study. The limitations of this study are the object of this study is Pacitan CFPP so the respondents who became the object of the survey were customers associated with Pacitan CFPP as mentioned at section 2.1 and the references used as the basis for evaluating quality attributes are SLA of and customer satisfaction indicators in the 2021 service level agreement (SLA).This study assumes that there are no problems in Gap 1 to Gap 4 so that this research will focus on Gap 5 (the gap between service expected and received service).

a. Priority of Pacitan CFPP O&M Service Quality Attributes

In this study, 25 quality attributes for Pacitan CFPP O&M Service are identified and by using Servqual method we can see that all of the quality service attributes have negative gap scores, this shows that all of the attributes need to get attention for process and quality improvement so PT PJB can satisfy the need of its customer. The lowest gap score is Quality overhaul/inspection (R1) which value is -0.67. Meanwhile, the lowest satisfaction score is the same attribute Quality overhaul/inspection (R1) which value is -2.96. However, the lowest average gap score and satisfaction score related to attributes on the Responsiveness Dimension which values are -0.53 and -2.38 respectively. It means that in this aspect respondents consider that PT PJB willingness to help customers and provide prompt service still have to be improved.

By using Kano Model it is found out that there are no attributes that fall into 'Indiferent',' Reverse' or 'Questionable' category. There are 3 attributes in 'Must Be' category : Adequacy of mandatory spare parts/materials and tools in Operations, Maintenance, Engineering (T1), Adequacy of the number and competency of human resources in Operations, Maintenance, Engineering (T2), and Accuracy in the preparation of the Work Plan Program (A1). The management of PT PJB must immediately fulfill all attributes in the Must Be category because this attribute is the mandatory attributes so the fulfillment of these attributes should be the most prioritized otherwise the customer will feel disappointed or even change their provider of O&M service. There are 2 attributes in 'Attractive' category : Maintenance mix ratio (R4) and Understanding customer needs in preparing Risk Management Documents as well as communication and coordination in submitting the Investment Budget (E4). So if these attributes are fulfilled customer satisfaction will be increased very high and also can be used as process innovation. The remaining 20 other attributes are in 'One Dimensional' category. This category is linear with the customer satisfaction, so PT PJB Management fulfills this category, the customer will feel satisfied and vice versa. By integrating Servqual method, Kano model and QFD we can prioritize Pacitan CFPP O&M Service quality attributes which can be seen at Table 1.

Table 1. Priority of Pacitan CFPP O&M Service Quality Attributes

Attributes	Code	Gap Score	Satisfaction Score	Kano Category	Normalized Raw Weight	Rangking
Maintenance mix ratio (ratio of planned maintenance compared to all types of maintenance)	R4	-0.50	-2.20	A	0.1040	1
Understanding customer needs in preparing Risk Management Documents as well as communication and coordination in submitting the Investment Budget	E4	-0.43	-1.88	A	0.0729	2
Quality overhaul/inspection	R1	-0.67	-2.96	O	0.0728	3
Speed and accuracy of failure and derating recovery of power plant	Rs 1	-0.63	-2.87	O	0.0700	4
Speed and accuracy of overhaul/inspection	Rs 2	-0.60	-2.66	O	0.0646	5
Speed in procuring Consumable Materials, Critical Parts, Spare	Rs 3	-0.57	-2.57	O	0.0616	6

Attributes	Code	Gap Score	Satisfaction Score	Kano Category	Normalized Raw Weight	Rangking
Parts, and Tools and including repair services from third parties						
The quality of the routine maintenance	R2	-0.57	-2.57	O	0.0614	7
Speed of power plant efficiency control	Rs 5	-0.57	-2.51	O	0.0603	8
Accuracy and efficiency in the procurement of Consumable Materials, Critical Parts, Spare Parts, and Tools	A3	-0.47	-2.05	O	0.0401	9
Accuracy and appropriateness of the absorption of the Work Plan Program (PRK)	A2	-0.47	-2.04	O	0.0399	10
Coal mixing accuracy	R3	-0.47	-2.02	O	0.0395	11
Availability and implementation of quality control standards for OH, PM, PdM, PAM, Operation	A5	-0.43	-1.88	O	0.0364	12
Adequacy of the number and competence of human resources in the field of Finance and Procurement	T4	-0.40	-1.71	O	0.0327	13
Accuracy and efficiency in procuring services to support maintenance activities	A4	-0.37	-1.59	O	0.0303	14
Adequacy of procedures and work instructions for Operations, Maintenance, Engineering	T3	-0.30	-1.36	O	0.0254	15
Speed of delivery of operational reports (Operation, Maintenance, LK3) monthly, quarterly, yearly	Rs 4	-0.30	-1.29	O	0.0242	16
Communication and coordination of annual, monthly, and weekly operational planning	E2	-0.27	-1.18	O	0.0220	17
Timeliness and accuracy of making Minutes of Work Handover and Billing	R5	-0.27	-1.16	O	0.0217	18
Adequacy of procedures and work instructions for Finance and Procurement	T5	-0.27	-1.16	O	0.0215	19
Communication and coordination of approval and establishment of the annual operating budget	E5	-0.27	-1.15	O	0.0214	20
Adequacy of mandatory spare parts/materials and tools in Operations, Maintenance, Engineering	T1	-0.40	-1.80	M	0.0173	21

Attributes	Code	Gap Score	Satisfaction Score	Kano Category	Normalized Raw Weight	Rangking
Adequacy of the number and competency of human resources in Operations, Maintenance, Engineering	T2	-0.40	-1.80	M	0.0172	22
Service and communication between power plant Operators and System Dispatchers	E1	-0.20	-0.89	O	0.0162	23
Accuracy in the preparation of the Work Plan Program (PRK)	A1	-0.33	-1.44	M	0.0137	24
Readiness and willingness to participate in recon regularly	E3	-0.17	-0.71	O	0.0129	25

From Table 1 we can see that the first priority of quality attributes that have to be improved is Maintenance mix ratio (ratio of planned maintenance compared to all types of maintenance) (R4) and the last priority of quality attributes that have to be improved is Readiness and willingness to participate in recon regularly (E3).

b. Priority of Technical Responses to Improve Pacitan CFPP O&M Service Quality

Technical responses for each attribute are identified by brainstorming with the PT PJB Management Team stakeholders of the O&M services. The development of Inter-Relationship Matrix is carried out by identifying the correlation between each technical responses and quality attributes (strong = 9, moderate 3, weak =1). Prioritization of the technical response is obtained by multiplying normalized raw weight from Planning Matrix with numeric weight of Inter-Relationship Matrix. This order is the priority order of improvement program of Pacitan CFPP O&M service. The priority of technical responses for O&M services of Pacitan CFPP can be seen in Table 2.

Tabel 2. Priority Program for Quality Improvement of Pacitan CFPP O&M Services

Priority	Technical Responses	Code	Contribution
1	Expanding the scope of work inspection/assessment.	RT2	10.94%
2	Evaluation of competency gaps and programs to accelerate competency improvement	RT9	10.60%
3	Review QC Standards for Overhaul, PM, PdM, FLM & Patrol Check Operators, and manufacture QC for each project/modification	RT13	9.08%
4	Review packaging of umbrella contracts for consumable materials and routine services	RT6	8.83%
5	Updating Communication SOPs and improving communication patterns with all stakeholders	RT15	8.57%
6	Review safety level, ROP, ROQ settings periodically	RT5	8.13%
7	Gathering program with internal key stakeholders (P2B, PLN regional, Coal Division) & External (Forkopinda, key suppliers)	RT11	8.03%

8	Evaluate the adequacy of all SOPs and IK Operations, Maintenance, Engineering, Finance, and SCM as well as regular reviews	RT10	7.17%
9	Addition of Inspection/Assessment Tools	RT7	6.40%
10	Time Base Maintenance of Vital equipment (Trip Unit) & Essential equipment (Derating Unit≥ 50%)	RT1	4.81%
11	Increasing the consistency of PM & PdM implementation with GEMBA	RT4	4.26%
12	Evaluation of the effectiveness and strengthening of the Organization & labor formation of Maintenance Repair and Overhaul Unit	RT8	4.26%
13	Maintaining the Consistency of the Oncall Team	RT16	3.12%
14	Consistent implementation of combustion compliance & heat loss analysis of steam and water cycles	RT3	2.67%
15	Increase in coal unloading rate from 10,500 MT/day to > 13,000 MT/day	RT14	1.75%
16	Making standard report formats and Reporting SOPs	RT12	1.39%

Considering each technical response contribution to customer satisfaction and by using the Pareto Analysis in Figure 2, it is recommended to PT PJB Management to focus on technical responses priority number 1 to 10 as improvement programs to upgrade O&M service quality and SLA achievement as well as customer satisfaction.

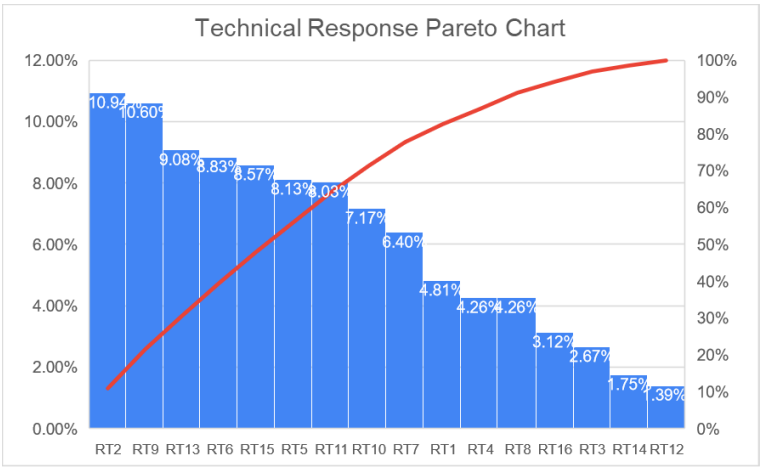

Figure 2. Technical Response Pareto Chart

15. Conclusion

After the previous stage of data collecting, processing, and analysis, the aim of this study, it is found out in this study that there are 25 service quality attributes of Pacitan CFPP O&M service which all of them still have to be improved since the satisfaction score is still negative, with Responsiveness Dimension as the lowest average satisfaction score. From the results of classifying quality attributes

using the Kano Model, all service attributes fall into important categories : 3 attributes fall into category M (must be), 20 attributes fall into category O (one dimensional) 2 attributes fall into category A (attractive). The first priority of quality attributes that have to be improved is Maintenance mix ratio (ratio of planned maintenance compared to all types of maintenance) (R4) and the last priority of quality attributes that have to be improved is Readiness and willingness to participate in recon regularly (E3).

Considering each technical response contribution to customer satisfaction from QFD and by using the Pareto Analysis, it is recommended to PT PJB Management to focus on 10 out of 16 technical responses as improvement programs to upgrade O&M service quality and SLA achievement as well as customer satisfaction which are Expanding the scope of work inspection/assessment (RT2), Evaluation of competency gaps and programs to accelerate competency improvement (RT9), Review QC Standards for Overhaul, PM, PdM, FLM & Patrol Check Operators, and manufacture QC for each project/modification (RT13), Review packaging of umbrella contracts for consumable materials and routine services (RT6), Updating Communication SOPs and improving communication patterns with all stakeholders (RT15), Review safety level, ROP, ROQ settings periodically (RT5), Gathering program with internal key stakeholders (P2B, PLN regional, Coal Division) & External (Forkopinda, key suppliers) (RT11), Evaluate the adequacy of all SOPs and IK Operations, Maintenance, Engineering, Finance, and SCM as well as regular reviews (RT10), Addition of Inspection/Assessment Tools (RT7) and Time Base Maintenance of Vital equipment (Trip Unit) & Essential equipment (Derating Unit≥ 50%) (RT1)

16. References

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