Quality Improvement of Overhaul Maintenance Service using Servqual and Quality Function Deployment Method Case Study in PT. Pembangkitan Jawa Bali (PJB) UPHT Gresik

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Abstract—**Electricity is the right of every person guaranteed in the 1945 Constitution, it must be realized in the form of providing electricity supply for the community. Electricity generators in Gresik are one of the power suppliers for industries and communities through the distribution managed by one of the electricity distributor in Indonesia. As time goes by, the plant needs to do a planned maintenance called overhaul. This research aims to improve the quality of overhaul maintenance service to one of the generators that exist in Gresik. The other goal is to know what service factors that affect the level of customer satisfaction in accordance with customer expectations based on service priority variables. Measurement of service quality of overhaul maintenance is done by combining ServQual method and Quality Function Deployment (QFD) method.**

Keywords—**Overhaul Maintenance, ServQual Method, Quality Funtion Deployment (QFD).**

I. INTRODUCTION

PT PJB is a subsidiary of PT PLN (Persero), previously known as the National Electricity Company (PLN), which acts as a holding company. PT PJB encourages the development of the national economy by providing high-quality, reliable and environmental friendly electricity. Initially, PJB's core business was only generating electricity from its six Generating Units (UP): UP Gresik (2,219 MW), UP Paiton (800 MW), UP Muara Karang (908 MW), UP Muara Tawar (920 MW), UP Cirata (1,008 MW), and UP Brantas (281 MW). In early January 1998, PT PJB formed several Business Strategy Units, one of them is the Maintenance Business Unit (UBHAR). In order to optimize organizational performance in accordance with business dynamics, in early April 2007 PJB did alignment and reorganization of its function. Business processes and basic tasks in the organization of the Maintenance Service Unit were formed by establishing the PT PJB Western Regional Maintenance Service Unit and PT PJB Service Unit Maintenance of the Eastern Region focused on power plant overhauls. A project is defined as a series of unique activities that are related to achieve a certain result and carried out in a certain time period. According to (PMI, 2017) a project has several important characteristics contained in it namely Temporary (Temporary), called temporary means that each

project always has a clear schedule when it starts and when it is completed. Projects also have unique characteristics, which mean that each project produces a certain product, solution, service or output that is different from one another. This is inline with the UPHT business process, which is a power plant maintenance service unit, so that the output is in the form of maintenance services and continous assessments.

The Eastern Regional Service and Maintenance Unit or commonly referred to as UPHT is one of the work units of PT. PJB. UPHT has the main task of providing maintenance services either power plants overhaul or equipment maintenance projects. Overhaul is a planned maintenance activity that is carried out periodically on all equipment components in a generator engine unit. The process starts from reading historical data or history of operations and maintenance, retrieving operational performance data before the engine is shut down, dismantling, checking evaluating, repairing and replacing damaged equipment components, reassembling and re-testing, operating tests, commissioning, and retrieval of operational data after overhauling / inspection. From the results of the overhaul / inspection activities, the generator engine can be predicted to be continuously operated again for one year following the next operating period in accordance with the operation standard eligibility stipulated in the operating manual. Strategic overhaul of generating units has a very important role in the management of generating units. There is a link between the overhaul of generating equipment and the reliability of power plant performance [1] Foon and Terziovski 2014 . The results can be seen in the konkin evaluation in 2013 - 2018, there was a decrease in the quality of work, increased work warranty and decreased timeliness in overhaul completion.

How to measure the quality of services in general is to know and compare between customer expectations with the service performance received. If customer expectations have a value greater than the actual performance of the services received by customers, then the level of satisfaction is lower. The man power involved in maintenance and operation services until the next overhaul are 60 operators, 25 maintenance and 12 people rendal maintenance / MO / Operations .The total population are 97 people. Based on this, a study was conducted to increase customer satisfaction of
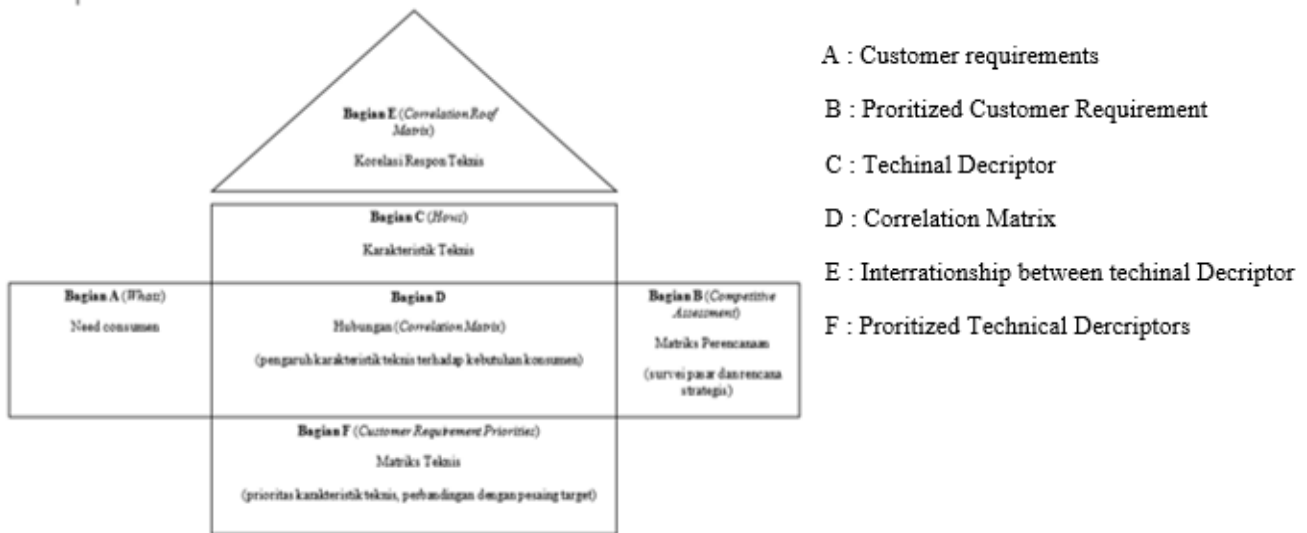
Figure 1. House Of Quality.

overhaul maintenance services at PT. PJB UP Gresik. The servqual tool is used to measure the quality of generators maintenance services overhaul while the factors / criteria that affect the level of customer satisfaction in the quality of work overhaul services and priorities can be achieved using the Quality Function Deployment (QFD) method.

II. METHOD

A. Servqual

Service quality starts from a collaboration between the three leading experts [2] A. Parasuraman, Valarie A. Zeithaml dan Leonard L. Berrry pada tahun 1985 The reputation of these three experts starts from their conceptual paper entitled "*A Conceptual Model of Service Quality and its Implications for fututre Research*" published in journal of marketing. In the journal, they meticulously describe the five service quality gaps that have the potential to be sources of service quality problems. This model called service quality was developed with a view to assist managers in analyzing the sources of quality problems and understanding ways to improve service quality. There are five dimensions used to measure the quality of a service in an industry according to Parasuraman [2] :

1. Reliability: : the ability of the company in the product / service in providing services as promised precisely, accurately and reliably then the performance must be in accordance with customer expectations.
2. Responsiveness: The ability to help and provide the best service to customers and care for customer complaints and expectations.
3. Assurance: The dimensions measured by the ability trust and politeness of workers so as to make it free from danger, risk or doubt and politeness.
4. Empathy: Dimensions measured by the ease of communicating with customers, paying attention to customers, and understanding the will of the customer.
5. Tangible : The dimension by the ability to show physical form in which appearance, ability of facilities, physical infrastructure and environmental conditions so as to provide tangible evidence of services provided by service providers in the form of physical facilities (buildings), equipment and equipment (technology), and means of communication or information.

B. QFD

According to[3] Akao 1990 QFD is a method for developing design quality that aims to satisfy consumers and then translate consumer demand to design targets and key quality assurance points that can be used in the production phase.From some of the definitions above, Quality Function Deployment (QFD) can be concluded as a design system of goods or services based on consumer desires which in the process will involve all members and organizational functions to be able to compile QFD.

In Figure 1, House of Quality (HoQ) is a tool that supports the QFD method, using a matrix that connects consumer desires with design steps and compares design steps so practitioners can concentrate on the most important and valuable characteristics. The term "home" is used because the QFD tool used looks similar to a house with several rooms and a roof. The HoQ matrix was first used in the process of displaying Voice of Customer (VoC) or consumer needs for technical responses.

C. Power Plant Maintanance in PT PJB

Maintenance is all activities carried out to maintain the condition of an item or equipment, returning it to certain conditions [4] (Dhillon, B.S 2006). Quoting [5](Froger et al. 2016) that Maintenance is an action that is needed to ensure that a product provides reliable service. Maintenance can be divided into two categories: corrective and preventive. Corrective maintenance is maintenance carried out after damage occurs. Preventive Maintenance is carried out at predetermined intervals or in accordance with specified criteria and is intended to reduce the possibility of failure. Maintenance in the electricity industry concerns overhaul, namely maintenance on a large scale with a vulnerable period of time [5](Froger et al. 2016). Overhaul or Outage Management plant maintenance project is a project that contains comprehensive maintenance activities for power

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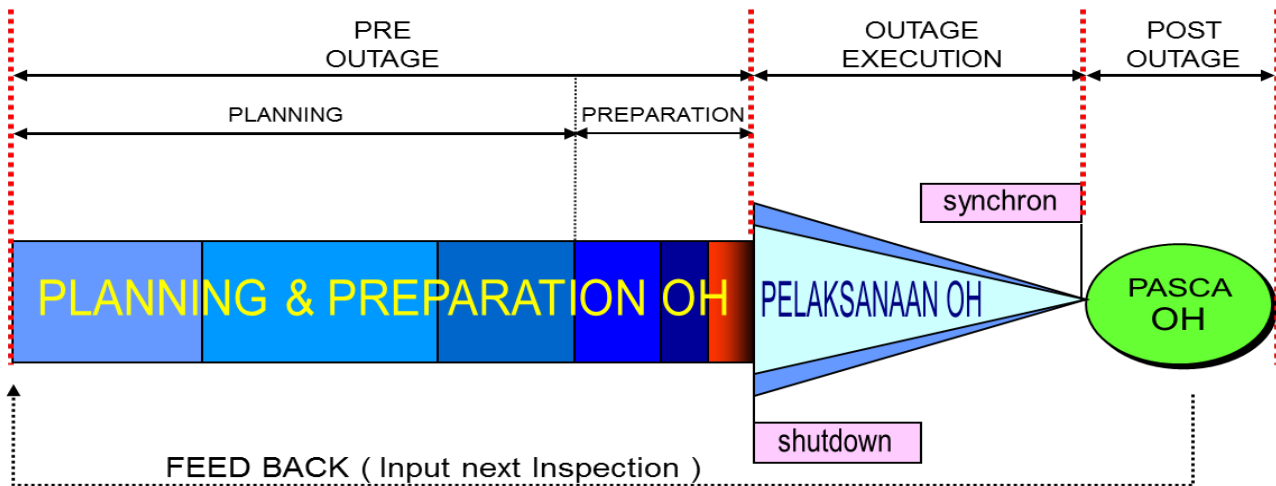
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Figure 2. Frame Work Outage Management in PT PJB.

plant equipment aimed at returning the power plant to its original condition. In the implementation of power plant maintenance projects at PT. PJB uses a system called Outage Management. Outage Management is the merging of the planning, preparation, implementation, control, monitoring, evaluation and follow-up plans after the maintenance process shown in Figure 2, including:

1. Pre Outage Stage : The Pre-Outage Phase includes the Overhaul planning and preparation activities
2. Outage Execution Stages are the stages of the implementation of Overhaul
3. The Post Outage Stage is the evaluation phase of the results of the Overhaul implementation

III. RESEARCH METHOD

Problem identification is a stage to recognize a problem. The purpose of identifying problems in order to know the problem exists and is relevant to the title of this study. The problems to be identified are PT. PJB UPHT Gresik

1. Stage literature study and data colection : At this stage what will be done to obtain data from the variable of consumer desires is to provide a questionnaire about the attributes that contain dimensions of Servqual, to employees of PT. PJB UP Gresik which operates, plans and maintains power plants.
2. Population and sample determination : Population and sample determination in this study are the sub-warehouses in the UP Gresik generating unit, the researchers only used a sample of sub-fields of engineering that contained maintenance, rendal and operator can be shown in Table 1. Noting these characteristics, the method used is simple random sampling. Determination of the amount of sampling using the Slovin Formula :

$$n = \frac{N}{1 + N(e)^2} \qquad (1)$$

Using the above equation, the number of samples is 69 (sixty nine) respondents.
3. Validity dan reliability test : It aims to determine the condition of satisfaction with the service at this time an initial survey of 15 (fifteen) respondents

4. Processing stage data : This stage contains the results of the questionnaire processed and analyzed using Servqual data, Important Performance Analysis (IPA) and House of Quality (HoQ). Servqual is used to find out the gap between expectation and perceived, IPA is used to know variables of importance, and HoQ is used to determine the technical response to improvement of variables.

IV. DATA ANALYSIS OF SERVQUAL, IPA DAN HOUSE OF QUAITY

The results of validity and reliability tests on the Form of interest and satisfaction that has been done with 15 respondents stated that the questionnaire that has been made is valid can be shown in Table 2. Validity and reliability test used software SPSS25.

A. Service Quality

By using the Servqual method, there are 5 (five) highest value gap between customer perceptions and expectations, Gap 5 (Five) from Servqual are customer perception vs customer satisfication. Gap obtained from the difference between the average variable of interest rate with the average level of overhaul satisfaction, such as :

1. Workforce competence (assurance) average gap : -0,580
2. Work order (WO) warranty (realibility) ratio average gap : -0,507
3. Work is carried out in accordance with existing Standard Operation Procedures (SOP) in the company (Realibility) : -0,391
4. Availability and completeness of work procedures (Work Instructions) (tangible) : -0,333
5. Accuracy of recommendations for next overhauls (assusrance) : -0,290

B. IPA

Using IPA method for counting interest data result and perception data can be show in Figure 3.

From the diagaram in Figure 3 a shown that :

1) The Variable in Quadran I are :

a. Accuracy in material / service specifications
b. Work Order ratio warranty

Table 1.
Number of research repondent

Number	Bidang	Customer	Responden
1	Operator	60	37
2	Maintanance	25	20
3	Rendal	12	12
	Total	97	69

Table 2.
Realibility skor

No	Data Type	Total Variable	Cronbach alpha
1	Expectation Data	17	0,967
2	Perception Data	17	0,943
3	Interest Data	17	0,970

c. Workforce competence
d. Availability and completeness of work procedures (Work instructions)
e. Availability and completeness of K3
f. Availability and completeness of tools

2) The Variable in Quadran II are :

a. Work is carried out in accordance with existing SOPs in the company
b. Time of work in accordance with the specified schedule
c. Concern for LK3
d. Concern for company assets

3) The Variable in Quadran III are :

a. The accuracy of closing WO
b. Accuracy of recommendations for subsequent overhauls
c. Good coordination between UP and UPHAR

4) The Variable in Quadran IV are :

a. Work is carried out in accordance with existing SOPs in the company
b. Ability to accommodate work outside the scope of the project / overhaul
c. Sharpness of problem analysis

From the IPA analysis it is known that the variables included in Quadrant I are:

1. Accuracy in material / service specifications
2. Work Order ratio warranty
3. Workforce competence
4. Availability and completeness of work procedures (Work instructions)
5. Availability and completeness of K3
6. Availability and completeness of tools

C. HoQ

Technical responses were obtained from the results of discussions and brainstorming with the Technical Manager, Renbintek Manager, Supervisors of all engineering fields at PT PJB UPHT. The technical responses were used as feedback on the survey variables after the data analysis in Figure 4. At last, the value of Final Importance rating for Customer Needs (FIRCN) can be obtained by calculating the value of goals, Sales Points, and Important Ratings.

$$FIRCN = (Goal \div interest\ data) \times Sales\ Point \qquad (2)$$

From the results of the discussion and brainstorming, the following technical responses can be shown in Table 3. The
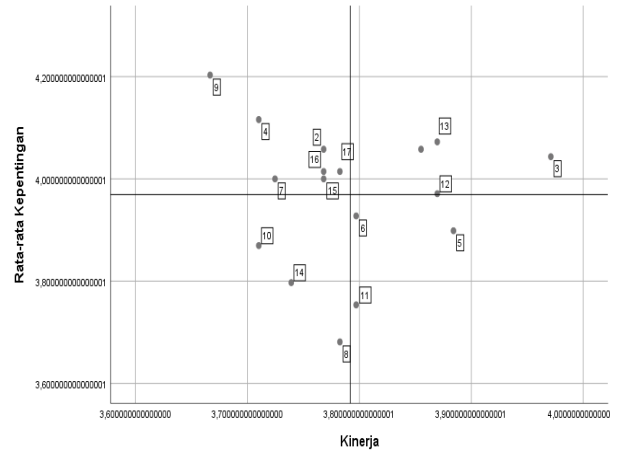

Figure 3. IPA diagram of customer satisfaction.

Table 3.
Technical respon

Respon Teknis	Scor	Ranking
Doing Job Shadowing and Sharing Knowledge	127,27	1
Working based on standard operation procedure	97,22	2
Making warranty monitoring (WO)	83,21	3
Making tools innovation to accelerate the Overhaul process	81,58	4
Brainstorming and Benchmarking to World Class Service	77,87	5
Updating and adding new work instruction procedure	61,08	6
Providing training to techinal employees	58,53	7
Making web materials and services	49,17	8
Making web creation tools	47,91	9
Peforming tool calibration and checking	43,71	10
Annual K3 equipment planning	38,48	11
Sorting material and services based on the same 3 years	26,7	12
Application and procedures for handling environmental hygiene and K3	12,83	13

results of the data in Table 3 rank 4 (four) that need to be considered as input to the UPHT :

1) Doing Job Shadowing and Knowledge Sharing

Technical responses Perform Job Shadowing and Knowledge Sharing get the highest value of 127.27. By doing Job Shadowing and Knowledge Sharing, the mapping of competency of technical employees will be more evenly distributed and reduce knowledge gaps so that any overhaul maintenance work has good quality and reliable.

2) Working Based on Standard Operation Procedure

Technical response Performing Work Based on Standard Operating Procedures / Work Instructions has IRTR value of 97.22. Performing Work Based on Standard Operating Procedures / Work Instructions is useful to maintain and guarantee the quality of the plant in every inspection and measurement of equipment. By performing the work based on the basic work instructions / Standard Operating Procedures, the details of the work and results will always be good.

3) Making WO Warranty Monitoring

Making the Monitoring of WO warranty has third rank IRTR value of 83.21. By making a Monitoring of Work Order

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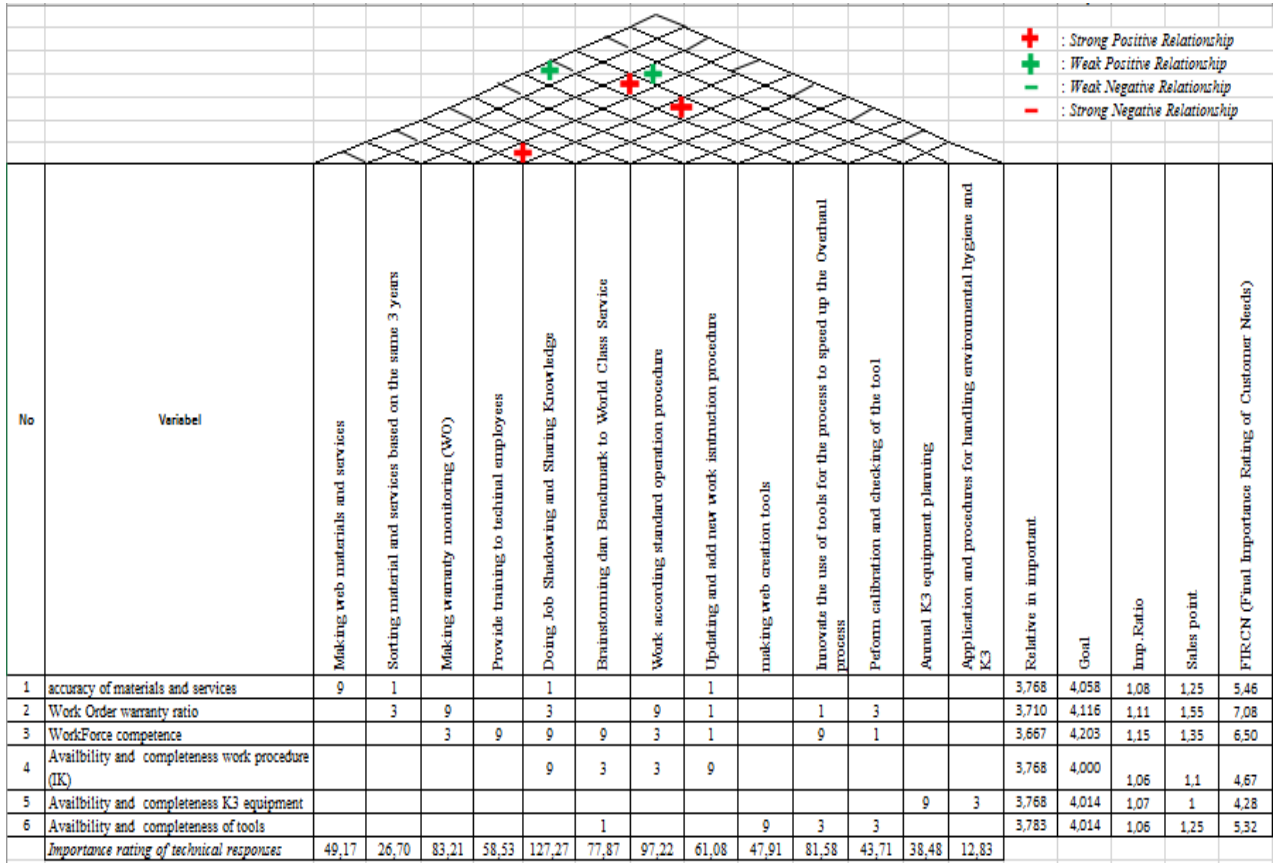| No	Variabel	Making web materials and services	Sorting material and services based on the same 3 years	Making warranty monitoring (WO)	Provide training to technial employees	Doing Job Shadowing and Sharing Knowledge	Brainstorming dan Benchmark to World Class Service	Work according standard operation procedure	Updating and add new work instruction procedure	making web creation tools	Innovate the use of tools for the process to speed up the Overhaul process	Peform calibration and checking of the tool	Annual K3 equipment planning	Application and procedures for handling environmental hygiene and K3	Relative in important	Goal	Imp.Ratio	Sales point	FIRCN (Final Importance Rating of Customer Needs)
1	accuracy of materials and services	9	1			1			1						3,768	4,058	1,08	1,25	5,46
2	Work Order warranty ratio		3	9		3		9	1		1	3			3,710	4,116	1,11	1,55	7,08
3	WorkForce competence			3	9	9	9	3	1		9	1			3,667	4,203	1,15	1,35	6,50
4	Availbility and completeness work procedure (IK)					9	3	3	9						3,768	4,000	1,06	1,1	4,67
5	Availbility and completeness K3 equipment												9	3	3,768	4,014	1,07	1	4,28
6	Availbility and completeness of tools							1			9	3	3		3,783	4,014	1,06	1,25	5,32
	Importance rating of technical responses	49,17	26,70	83,21	58,53	127,27	77,87	97,22	61,08	47,91	81,58	43,71	38,48	12,83					

Figure 4. Table HoQ.

warranty, indirectly UPHT will have data for equipment that has to be rework after the maintenance. The data then stored in the website form, so every UPHT employee will be able to know the work that has ever gotten rework. It can also be used to add experience to figure out the damage ever happened after the Overhaul of the Gresik plant so that no rework occurred.

4) Making Tools Innovation to Accelerate The Overhaul Process.

Making tools innovation to accelerate the overhaul process is ranked fourth (4th) with an IRTR value of 81.58. By making tools innovation, a job that was previously difficult can be facilitated so that it will have an impact on the time and quality of overhaul. The more tools innovation implemented in overhaul will make it easier to manage the planned work time and improve overhaul services in the Gresik Generating Unit.

REFERENCE

[1] K. Kotler, P. and Keller, *Marketing Management MARKETING MANAGEMENT Marketing Management*. 2006.
[2] A. Parasuraman, V. A. Zeithaml, and L. L. Berry, "A Conceptual Model Of Service Quality and Its Implication for Future Research," *J. Mark.*, vol. 49, no. 4, pp. 41–50, 1985, doi: 10.2307/1251430.
[3] P. Y. Akao, "The Method for Motivation by Quality Function Deployment (QFD)," pp. 1–10, 2014.
[4] P. D. Dhillon, B.S, "ENGINNERING MAINTANANCE; A Modern approach," Section 1., no. 6, New York, 2006, pp. 17–23.
[5] A. Froger, M. Gendreau, J. E. Mendoza, É. Pinson, and L. M. Rousseau, "Maintenance scheduling in the electricity industry: A literature review," *Eur. J. Oper. Res.*, vol. 251, no. 3, pp. 695–706, 2016, doi: 10.1016/j.ejor.2015.08.045.