Service Quality Improvement Strategy for Container Terminal using SERVQUAL and House of Quality

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Abstract

Container terminal is one of the crucial parts in the port area. The increasing number of a customer complaint about the services is one of the main problems nowadays. This research aims to design a service quality improvement strategy for container terminal in Tanjung Priok port area. The SERVQUAL method applied to measure the gap between customer perception and expectation. The results from SERVQUAL will be categorized with Importance Performance Analysis (IPA) to determine which service attributes need improvement. The alternative strategies are generated by literature review and interviewing the expert. IPA and alternative strategy results are included in House of Quality (HOQ) matrix to determine strategic recommendations priority. The results of this research has the best strategy to improve service quality in Tanjung Priok container terminal.

Keywords
Container Terminal, Service Quality (SERVQUAL), Importance Performance Analysis (IPA), House of Quality (HOQ)

1. Introduction
Indonesia is one of the largest archipelagic countries in the world and also ranks second as the longest coastline in the world, so that 2/3 of Indonesia's territory is a sea area (UNCLOS 1982). Indonesia as an archipelagic country with a maritime pattern has the potential to become a shipping center and axis of world maritime trade. In 2016, the maritime sector in Indonesia contributed 6.04% of Indonesia's GDP, which was IDR 749 trillion and was also able to absorb as much as 3.6 million workers or 3.08% from total workers in Indonesia (Central Bureau of Statistics, 2017).

One of the uses of the maritime sector in Indonesia is through transportation and trade, with the role of ports. Port development needs to be done immediately as one of the focuses to help improve national logistics competitiveness (Mego 2017). The need for port development investment financing is carried out to realize a sea port development plan that is adjusted to the projection of container traffic in Indonesia until 2030 (Menteri Perhubungan 2013).

Container terminal is one of the most important parts of the port which has several kinds of services, namely gate, billing, dumping ground, and receiving / delivery. Container traffic in Indonesia has increased from 2008 to 2018, amounting to 12.85 million TEU at the end of 2018 (CEIC, 2020). Container traffic in Indonesia is projected to continue to increase to 21 million TEU in 2030 (Menteri Perhubungan 2013).

The current situation at Indonesia's Container Terminals has an increase in the number of customer complaints that occurred by 53% in 2016 (Sari 2017). This research aims to design a service quality improvement strategy for container terminal in Tanjung Priok port area. This research conducted with Service Quality or so-called SERVQUAL method to measure the quality of container terminal services and the House of Quality (HOQ) to determine the priority attributes that need to be improved and the priority strategies that must be done first to improve attribute performance. Finally, the strategic priority chosen is what the container terminal should do in order to improve their quality of services.

2. Literature Review

2.1 Container Terminal

Terminal is a meeting place between land and sea transportation modes which are responsible for the transfer of containers from land to sea transportation modes or vice versa. The function of the Container Terminal based on (Supriyono 2010) is as a place for loading and unloading containers from trucks or vice versa, packing and unloading Containers (CFS), monitoring and guarding containers and their cargo, receiving ships, and cargo handling of containers and storage areas services. According to (Triatmodjo 2009) facilities at the container terminal can be in the form of, among others, docks, aprons, container yards, Container Freight Station (CFS), control towers, maintenance workshops and other facilities such as driveways, office buildings, parking lots, and others.

2.2 Service Quality (SERVQUAL)

Service quality or so-called SERVQUAL defines customer evaluation of the quality from the gap between expected and perceived service (Dachyar et al., 2018). Research using SERVQUAL is limited to (Zeithaml and Berry 1988), namely there are five dimensions that represent service quality, namely Assurance, Empathy, Reliability, Responsiveness, and Tangible. There are several reasons for using SERVQUAL as stated by (Fainusa, Nurcahyo, and Dachyar 2020), such as (1) Because SERVQUAL is a useful indicator to identify services that needs to be improved (2) Because SERVQUAL developed from the perspective of customer; (3) Because SERVQUAL is the most well-known tools and also commonly used to measure the service quality.

2.3 House of Quality (HOQ) Matrix

House of Quality (HOQ) known as a product planning matrix that applied to describe customer needs, technical measures, and target values (Maritan 2017). The HOQ matrix or quality house is the best-known form of the Quality Function Deployment (QFD) representation. HOQ matrix consists of 2 parts, first the horizontal part of the matrix is customer table that contains information about consumer needs, and the vertical part of the matrix is technical table that contains technical response about consumer input.

The QFD process is divided into 4 stages, in practice any number of levels can be used as needed or whatever seems suitable. The first stage called the "House of Quality" is the most well-known matrix and considered as the most important element in the QFD (M, KC, and TN 2003). According to (Cristiano, Liker, and White 2001), most US companies only use the House of Quality Matrix in adopting QFD. Based on a review of QFD papers, approximately there are up to 33% of articles that considered to concentrate only on HOQ (Maritan 2017).

3. Methods

The study was conducted on Tanjung Priok Container Terminal services. The respondents for this study are Tanjung Priok Container Terminal Customers who have been receiving the service since the end of 2019 until 2020. In this study, there are 25 SERVQUAL attributes that are used to ask the customers from several study literatures ((Hemalatha, Dumpala, and Balakrishna 2018) (Sayareh, Iranshahi, and Golfakhrabadi 2016) (Hsu, Yu, and Huang 2015) (Capah 2013)) that can be seen in Table 1. The scale used in the questionnaire is likert scale five points to answer the question about the expectation and perception of every services attributes. The minimum number of respondents needed in this research are 94 calculated using slovin formula.

The number of respondents obtained in the study was 100 people with the characteristics of the majority of respondents' business types were freight forwarder companies (33%) then Shipping Line (25.9%), Loading and Unloading Companies (22.2%), and Cargo Owners (18.5%). The results of the questionnaire that have been obtained are tested for its validity and reliability. Validity test used to decide whether the questionnaire is valid or not by comparing the calculated r value of each attributes with the r table value of 0.196 obtained with the 95% degree of freedom and 98 degrees of freedom. The r value from each attribute in this study is more than 0.196 then it can be declared valid. Reliability test used to decide whether the scale used is consistent or not by comparing the Cronbach Alpha value. The Cronbach Alpha value for this questionnaire is more than 0.7 then it can be declared reliable. Because all of the data from questionnaire came out reliable and valid so it can be process further to the data processing.

Table 1. SERVQUAL attribute

No.	Dimension	Services Attributes
A1	Tangible	Stacking field availability
A2		Stacking equipment availability
A3		A neat and professional appearance of staff
A4		Billing Center availability
A5		Condition of port supporting facilities
A6		Port road access conditions
A7		Stacking equipment condition
B8	Reliability	The suitability of the invoice issuance
B9		Container safety and security
B10		Document creation accuracy
B11		Container tracking service
B12		Ease of placing orders
B13		Ease of Payment process
C14	Responsiveness	Speed of loading and unloading
C15		24/7 gate service
C16		Use of the Terminal Operation System (TOS)
C17		Ability to handle customer requests
C18		Document handling speed
D19	Assurance	Services are carried out according to the SOP
D20		Officer ability in handling customer complaints
D21		Completeness of container terminal support facilities
D22		Scale value accuracy
D23		Distribution of container stack locations
E24	Empathy	Friendly and polite clerk service
E25		Information that is clear and easy to understand

In conducting this study, there are several steps that need to be done after the data is proven valid and reliable, namely processing the results of the SERVQUAL questionnaire to determine the gap between the expected data and the perception of satisfaction from the quality of service received by container terminal customers and then proceed to categorize the SERVQUAL attributes into IPA to determine the attributes the quality needs to be improved. Furthermore, the selected attributes from the IPA results are entered into the house of quality matrix as customer requirements then followed by conducting interviews with experts and literature studies to formulate strategies that will serve as a technical response. Then calculate the relationship in the HOQ matrix between the customer requirements and the technical response to determine the priority strategies that need to be done to improve the quality of container terminal services. But before that it is also necessary to distribute SERVQUAL questionnaires to container terminal customers to determine the level of importance and satisfaction of each attribute.

4. Results and Discussion

The results of data collection through the SERVQUAL questionnaire will be continued by calculating the customer satisfaction index, the SERVQUAL dimension gap and mapping each attribute into a Cartesian Importance Performance Analysis diagram to decide which attributes needs to be improved and become input customer requirements on the HOQ matrix. Furthermore, interviews with experts and study literature were carried out to formulate strategies that would become input technical responses to the HOQ matrix. Finally, there is the House of Quality (HOQ) matrix which functions to prioritize technical responses that need to be carried out by the company.

4.1 Customer Satisfaction Index

Customer Satisfaction Index (CSI) is a method for measuring customer satisfaction through certain attributes. The purpose of using this method is to see the level of community satisfaction with the services provided by the Container Terminal as a whole and then compare it with the expectations of service interests expected by the community. The following is the result of calculating the Customer Satisfaction Index, starting from calculating MSI, MSS, WF, and WS as follows:

The method used to measure the Customer Satisfaction Index is divided into four stages ((Utomo and Wijaya 2013) (Suroto, Nindiani, and Purba 2017) (Fitriana et al. 2014)), first, calculating the Mean Importance Score (MIS) and the Mean Satisfaction Score (MSS) which generated from the average of importance and satisfaction score of each respondent. Second, calculating the Weighting Factor (WF) obtained from the percentage of the MIS value per attribute to the total MIS of all attributes. Third, calculating the Weighting Score (WS) by multiply the WF with the MSS, and finally calculating the CSI by dividing the total of the weighting score with the maximum value of the scale used in the questionnaire.
The final CSI calculation is performed using the following formula:

$$\text{CSI} = \frac{\sum_{i=1}^{n} WSi}{5} = \frac{360{,}449}{5} = 72{,}09\%$$

Based on ((Utomo and Wijaya 2013) (Suroto, Nindiani, and Purba 2017) (Fitriana et al. 2014)). regarding the classification level of customer satisfaction, the rate of 72.09% is at the level of satisfaction. Overall, the customer satisfaction value is said to be satisfied, but this value still needs to be further evaluated by analyzing the gap from the level of satisfaction with the level of importance of each attribute to find out which attributes have not met customer desires (Fitriana et al. 2014).

4.2 SERVQUAL Dimension

Service quality is the degree of differences between expectations and perceptions of the service performance (M Dachyar and Hananto 2014). If the value of the gap range is positive, it means that consumers feel the service received is as expected because it has exceeded expectations. However, if the value of the gap range is negative, consumers feel that the quality of the services provided is not in meet the desired expectations. For the SERVQUAL questionnaire, the average value of the expectation and perception was calculated using Geometric Mean, due to the better accuracy compared to the Arithmetic Mean, and also the number of error from Geometric Mean is less than the Arithmetic Mean (Muhammad Dachyar 2015). The results of calculating the gap from each SERVQUAL dimension is shown in Table 2.

Table 2. SERVQUAL Gap Calculation

Dimension	Expectation	Perception	Gap
Tangible	4,15	3,48	-0,67
Reliability	4,19	3,48	-0,71
Responsiveness	4,19	3,48	-0,71
Assurance	4,18	3,50	-0,68
Empathy	4,18	3,49	-0,69

The value gap for all the SERVQUAL dimension have a negative value which indicates that the service expectations desired by the customer have not been fulfilled optimally. The dimension with the biggest gap is reliability and responsiveness, while the one with the smallest gap is the tangible dimension.

4.3 Importance Performance Analysis

Importance Performance Analysis (IPA) method was introduced to measure the relationship between consumer perceptions and expectation about the services given to finally got the improvement priorities for the attributes. The result of the average value of the overall quality attributes of expectations and perceptions becomes the quadrant boundary for the Importance Performance Analysis diagram, where the mean (median) customer expectations become the intersection axis (y) representing the level of importance, and the mean (median) value of customer perceptions becomes the intersection axis (x) represents the level of service performance that has been provided to customers. The results of the division of IPA quadrant is shown in Figure 1.

Quadrant I is the top priority for quality improvement because it has a high level of importance but low satisfaction. Quadrant II is a supporting factor for customer satisfaction because it has a high level of importance and satisfaction so the quality must be maintained with the management. Quadrant III has a low level of satisfaction and importance to consumers, so that the management does not need to prioritize improving its quality. Quadrant IV is considered excessive because it focuses too much on things that are not considered too important by customers which should be allocated to other factors that have a higher priority for handling to improve their quality.

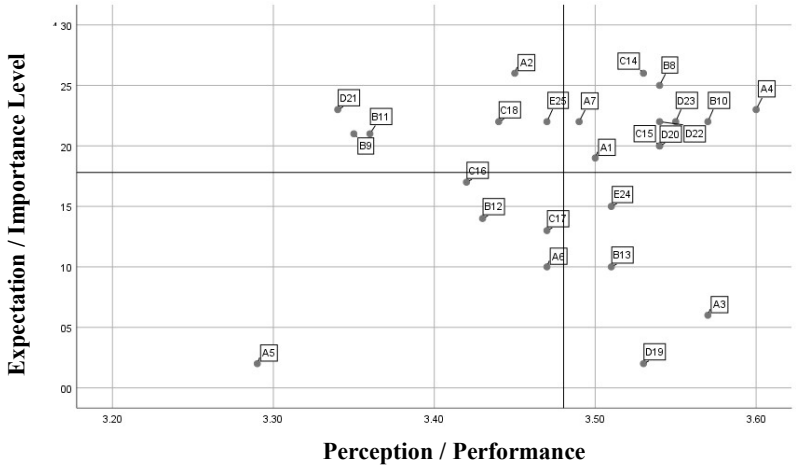

Figure 1. Importance Performance Analysis

Based on the division of the IPA quadrant, the attributes that need to be improved are those in quadrant 1, namely A2, B9, B11, C18, D21, and E25 because customers have high expectations of these attributes but the perception of satisfaction obtained is still low so that it is a top priority for quality improvement.

4.4 Strategy Generation

The technical response strategy is obtained by conducting literature studies ((Sharda 2019) (Yu and Fu 2018) (Deloitte Port Services 2018) (Liu et al. 2018) (Goussiatiner 2015) (Zrnic and BoSnjak 2005)) on strategies that have been and successfully applied in other container terminals to see how much impact these strategies have on the problems in the container terminal and stated in the Table 3.

Table 3. Alternative Strategies

No.	Strategies	Benefit
1	Automated Guided Vehicle	Manage cargo delivery traffic properly, reduce the chance of accidents and improve process efficiency at the port
2	Automotive Terminal Trailer	Improve maneuverability, energy efficiency and low emissions, and improve acceleration performance
3	Automatic Container-Code Recognition System	Increase the accuracy of the code recognition system in containers
4	Anti-Sway Ship-to-Shore Container Cranes	Helps control the movement of the container crane to reduce the sway that occurs while it is being moved
5	RFID	Improve the efficiency of identification and handling activities and enable better tracking and traceability of containers
6	Transparency of information on schedule of arrivals, departures and ship delays	Avoid overcrowding at container terminals

No.	Strategies	Benefit
7	Receiving Card dan Delivery Order Online	Make it easy for service users to apply for service documents

4.5 House of Quality Matrix

Making the HOQ matrix begins by entering the customer requirements into the column on the left and entering the technical response into the column at the top, then the relationship between the two columns in the middle is a relationship matrix which is used to find out how strong the relationship between technical response and customer requirements. There are three symbol that are used to know how strong the relationship is between Customer Requirements and Technical Response, circle with the dots means strong relationship (score : 9), empty circle means medium relationship (score : 3), and triangle means weak relationship (score : 1). Followed by entering the level of importance for each customer requirements obtained from the SERVQUAL questionnaire. Then the sales point level was found out that each attribute of the customer requirements in this study had the same sales point value at the level of influence. The last data needed is the improvement ratio by dividing the target value obtained by increasing the current satisfaction value in order to meet the desired satisfaction with the current satisfaction value obtained from the SERVQUAL questionnaire results. Then the three attributes, the level of importance, the sales point and the improvement ratio are multiplied to get the weight of each customer requirements. The House of Quality Matrix calculation will be shown in Figure 2.

		Technical Response (Hows)											
		Automated Guided Vehicle	Automotive Terminal Trailer	Automatic container-code recognition system	Anti-Sway Ship-to-shore container cranes	RFID	Transparency of information on schedule of arrivals, departures and ship delays	Receiving Card dan Delivery Order Online	Level of Importance	Sales Point	Improvement Ratio	Absolute Weight	Weight Percentage
Customer Requirements (Whats)	Stacking equipment availability	○	Δ						4,26	1,2	1,117	5,71	16,75%
	Container safety and security				○				4,21	1,2	1,128	5,70	16,71%
	Container tracking service			○		○			4,21	1,2	1,126	5,69	16,69%
	Document handling speed					Δ		○	4,22	1,2	1,113	5,64	16,53%
	Completeness of container terminal support facilities	Δ	○		Δ		Δ		4,23	1,2	1,133	5,75	16,87%
	Information that is clear and easy to understand			Δ			○	Δ	4,22	1,2	1,108	5,61	16,45%
Absolute Weight		0,671	0,673	0,665	0,670	0,666	0,662	0,660					
Priority Percentage		14,38%	14,43%	14,25%	14,35%	14,26%	14,19%	14,15%					
Degree of Difficulty		3	4	5	4	3	2	1					

Figure 2. House of Quality Matrix

After the weight of each customer requirements is obtained, the weight is multiplied by the value in the relationship matrix until finally the percentage of implementation priority for each technical response is obtained. Then the last data in the HOQ matrix is the degree of difficulty, which is the level of difficulty experienced by management in making policies in relation to consumer demands. Selection of the degree of difficulty depends on two main aspects, namely the price and time required to implement each technical response. The degree of difficulty was determined by giving five-point Likert scale, namely "Very difficult" on a scale (5), "Difficult" on a scale (4), "Fairly difficult" on a scale (3), "Easy" on a scale (2), " It's easy ”with a scale (1) (Maritan 2017).

Based on the calculations, the attribute of customer requirements that has the greatest weight is the completeness of the container terminal support facilities with a weight of 16.87%. Meanwhile, the technical response priority based

on the calculated priority percentage value is implementing the Automotive Terminal Trailer because it has the largest percentage, namely 14.43%.

4.6 Bottleneck Analysis

To determine the priority of the strategy or technical response that needs to be implemented, the container terminal does not stop at the final technical response priority percentage. Degree of difficulty as one of the aspects that needs to be considered has not been included in the calculation, so further analysis is needed to find out the final priority results that have considered the degree of difficulty of each technical response attribute. Degree of difficulty and percentage of priority are two very useful parameters for mapping two-dimensional characteristics (Obstacle Analysis). The X axis in the diagram shows the percentage of technical response priorities and on the Y axis the difficulty level of implementing technical responses (Maritan 2017).

The first quadrant is the bottom right hand side positions that contains important strategies and is easy enough to implement the Technical Targets and is usually called “Easy - High priority”. The second quadrant is on the lower left side positions that contains a low importance strategy but easy to implement called "Easy - Low priority". The third quadrant in the top left positions that contains low priority and very challenging strategies, namely “Difficult - Low priority” where the strategy needs to be revised because the level of important is too low. The fourth quadrant is the Bottlenecks strategies because the feature is very important to achieve full satisfaction from customers, but has challenging targets called “Difficult - High priority”.

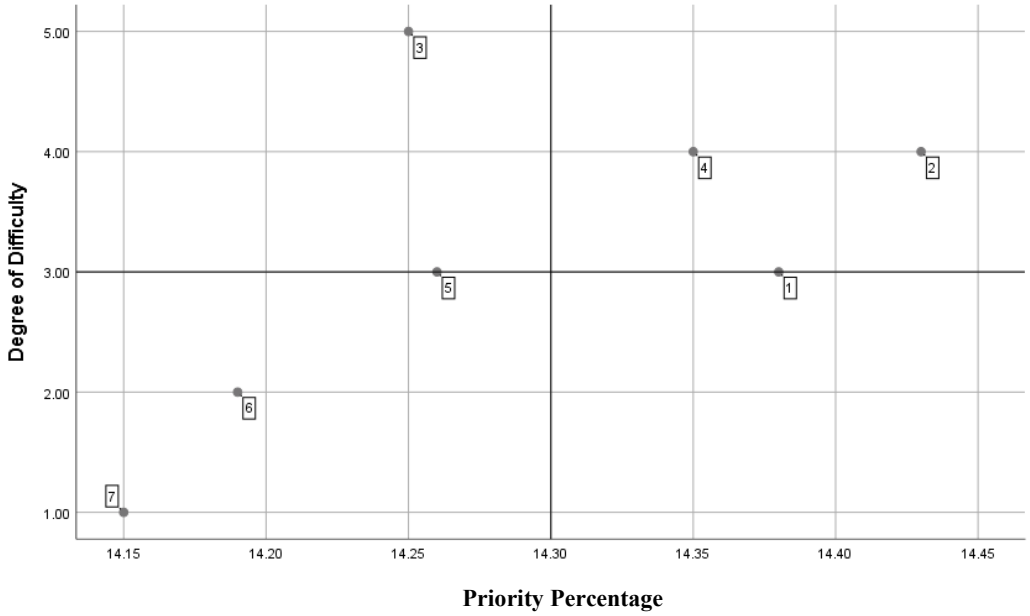

Figure 3. Bottleneck Analysis

Based on the division of the constraint analysis in the Figure 3, the technical response priorities that need to be implemented start from the first part, the second part, the fourth part and finally the third part. So, the main technical response priority that needs to be done by the container terminal is a strategy that is in part one, which has a large percentage of priority and a low degree of difficulty, namely implementing an Automated Guided Vehicle.

Automated Guided Vehicle is a strategy that occupies top priority because it relates to three attributes of customer requirements, namely the availability of container stacking equipment, container safety and security, and completeness of container terminal support facilities so that it ranks second in priority percentage. When compared with the technical response in the first rank in the priority percentage, AGV is superior in the value of the degree of difficulty it has so that when the two aspects of the priority percentage and the degree of difficulty are combined, the final result obtained as the main priority is AGV.

5. Conclusion

This study succeeded in explaining how customer satisfaction with the services provided by the container terminal using SERVQUAL and obtained a negative gap value on all SERVQUAL attributes. Based on the results of the division of the IPA quadrant, there are 6 SERVQUAL attributes that need to improve the quality of service. The attribute that has the greatest weight is the completeness of the container terminal support facilities. There are 7 alternative strategies to improve the quality of container terminal services. The best strategy that needs to be implemented based on the results of the HOQ matrix in normal circumstances is an Automated Guided Vehicle.

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