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Design Of Digitalization Of Lamong Bay Terminal Service System In Supporting Indonesian Sea Toll Program With Quality Function Deployment (Qfd) Approach

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ABSTRACT

Indonesia is a maritime country because it has a larger water area than land area. Indonesia has 17,499 islands that inhabit 3.25 million km2 of water from Sabang to Merauke. Therefore, sea transportation is one of the most important things that is used as a link between islands in Indonesia. Seaports are one of the most important parts of the marine transportation network in Indonesia in supporting the transportation of people and goods. Sea toll is a marine logistical transportation concept that aims to connect major ports in the archipelago. With this sea toll, it is hoped that it can reduce logistics costs and can maintain the stability of the price of goods and commodities between regions. The purpose of this research is to design a digital platform to optimize port services to be more effective and efficient in entering the industrial era 4.0 which will have an impact mainly from minimizing national logistics costs, dwelling time, balancing distribution channels and product prices, and reducing differences in operating costs ports between regions. This study, using the QFD approach which has several stages of planning and development through a matrix, one of which is the House of Quality (HoQ) matrix. In this method, it is used to link Customer Requirements (CR) and Performance Standards (PS) to identify relevant PS that affect the effectiveness and efficiency of the port system to the specified CR. With the role of the digital platform system for the seaport operational system, especially in Teluk Lamong Terminal, so that all stakeholder representatives can provide advice according to their institutional interests regarding the Indonesian sea highway program and solve it only in the mobile phone application. Based on the calculation of the House of Quality (HoQ), it can be analyzed that each technical response has a priority level so that it can be determined which attributes should be developed first. The technical response which is the first priority is system integration between stakeholders, the second priority is application data security, and the third priority is the dock activity information feature.

KEYWORDS

Customer Requirements, Digitalization, HoQ, Performance Standards, QFD, Sea toll

INTRODUCTION

Indonesia is a maritime country because it has a water area that is wider than the mainland. Indonesia is geographically an archipelagic country with two-thirds of the ocean area larger than the land. This can be seen from the coastline on almost every island in Indonesia along approximately 81,000 kilometers. Therefore, sea transportation is one of the most important things used as a liaison between islands in Indonesia. The port is one of the most important parts of the sea transportation network in Indonesia in supporting the transportation of

people and goods. Based on data from the Ministry of Transportation of the Republic of Indonesia, in 2013 the share of sea freight cargo by national shipping companies has reached 99.7%. Based on these data, it can be seen that the sea transportation system in Indonesia is very important. However, the quality of Indonesian ports is still ranked 96th in the world. This quality is assessed from the duration of dwelling time in Indonesia at the end of 2015 which took 5-6 days, while in Malaysia it was less than 4 days, and in Singapore it was only less than 2 days. this shows that the quality of the port can be greatly improved. (Martono, 2016).

The majority of Indonesia's infrastructure development is still concentrated on the island of Java, resulting in a price gap between goods in West Indonesia and East Indonesia (price disparity). To overcome these problems, the President of the Republic of Indonesia, Joko Widodo, launched the sea highway program. According to Presidential Decree No. 70 of 2017, the sea highway is an effective sea connectivity in the form of ships that sail regularly and on a scheduled basis from West to East Indonesia. The purpose and objective of the sea highway program is to reach and distribute logistics to disadvantaged and remote areas as well as to ensure the availability of goods and minimize price disparities as well as support development and economic growth in underdeveloped and remote areas to improve the welfare of the Indonesian people. The sea highway is also a barrier-free shipping lane that connects between regions through ports in Indonesia. The existence of this sea toll is expected to reduce logistics costs, maintain price stability of goods and commodities between regions.

On the other hand, Indonesia must also be ready to face the era of the Industrial Revolution 4.0 which can be marked by the emergence of automation and digitalization. This will have a significant impact on the future of Indonesia's port logistics system. Therefore, it is necessary to take a new model step for digitizing the port service system in order to optimize port services to be more effective and efficient in entering the industrial era 4.0 which will have an impact mainly on minimizing national logistics costs, minimizing dwelling time, balancing distribution channels and product prices, and reduce differences in port operating costs between regions.

METHODS

In the national logistics system, the distribution network pattern between maritime areas, maritime industry, and ports has undergone many developments to play its role in supporting the economic growth of a region. The fact is that seaports in Indonesia are mostly still conventional, especially in eastern Indonesia. The ineffective role of seaports in several regions in Indonesia can also affect distribution patterns and commodity prices in Indonesia. Therefore, Indonesia's maritime highway program to increase the nation's economic growth, especially through the optimization of the seaport system, is very important. In this study, we also provide another perspective for the existing literature by introducing the development of a seaport logistics resilience system to support Indonesia's maritime highway program in the industrial era 4.0. Several previous studies have discussed designs related to the development of a port logistics system, both at the strategic and operational levels.

[8], in his research, determined a viable solution for the implementation of knowledge management in ports, where the top five solutions include data storage and data mining system setup, decision support system set up, information and communication infrastructure development, database development for document management, and utilization of groupware and other software. In developing and increasing the growth of seaports, we must be able to facilitate the influence of cultural, institutional, and governance factors of the country of origin, the influence of the economic environment and competition in the domestic market, and stakeholder management [3]. [6], using a service quality approach, shows that logistic service users are conservative enough

that they carefully consider innovation. However, they fulfill IT integration and recognize the shortcomings of technology adaptation in the logistics process at various stages of customer service. In addition, [9], using the Structural Equation Model (SEM), determines several variables that improve port performance such as Servqual dimensions, brand awareness, brand loyalty, and the overall value of brand equity.

[4] in their study provide an overview of the current state of digitization in maritime logistics, discuss existing problem areas, and point out the potential for improvement. The results show that it is important to capture development potential to reap the benefits of the benefits. Based on the literature review, we reanalyzed the development of a digital seaport service platform system comprehensively in supporting the maritime highway system using the QFD approach.Several previous studies are using the QFD method; one of them is [1]. In their study, [1] tried to use the QFD principle to measure shipping investment related to the satisfaction level of shipping customers in the crude oil tanker market. There is also a QFD application in assessing the quality of ship services of Asian shipping companies [5].

[10] have adopted an integrated approach in their study, combining Analytic Hierarchy Process (AHP) and Quality Function Deployment (QFD). The combination is applied to select suppliers strategically. Based on ranking standards, alternative suppliers are assessed and compared with each other using AHP once again to make the optimal choice. In addition, [2] applied QFD to develop a service delivery system solution for the port in southern Taiwan, Port of Kaohsiung.

In the following research, the QFD approach is used to address problems including ocean supply chain resilience [11], and service quality [2] ; [5], where [11] try to explain several important steps in carrying out the QFD method. [11], in their other research on the ANP-QFD approach to the environmental sustainability of logistics service providers, proposed a methodology that uses systematic metrics for logistics service providers (LSPs) to develop their environmental sustainability performance in the context of green supply chain management. This is also confirmed based on our previous research, [7] on an analysis of the marine transportation system between Indonesia, Malaysia, and the US. The results of the descriptive analysis are shown in table 1.

Tabel 1. Marine Transportation Industry Comparison [7]

	Indonesian	Malaysia	USA
Operations and Policies for the Sea Transportation Industry	- There are about 70 main ports spread across 34 provinces. - Implementing the maritime highway program. - The main port is managed by the government as a state-owned company.	- There are about 7 main cargo ports. - Some ports are managed by private companies.	- There are about 100 major cargo ports. - Implementing the American Marine Highway program.
Application Perspective ERP system	- Menerapkan sistem informasi kelautan untuk otoritas otoritas pelabuhan internal. - Implementasi ERP masih belum optimal, dan hanya di beberapa port utama saja.	- Implementing a marine information system for each stakeholder. - ERP implementation has only been carried out in a few ports.	- Each port authority has its own information system.
ERP and IOT Platform	- Have not implemented the integration between ERP and IoT. - Has not integrated the entire service process of each stakeholder in all major ports.	- Has implemented the e- PAN application for the benefit of the early arrival of ships related to the security process of ships that will dock. - Implementation of the e-DCFZ application, which aims to facilitate document processing of dangerous cargo and free zone.	- Has not implemented an integration between ERP and IOT, especially for integration of all service processes.

Therefore, in this study, we propose an IOT concept architecture for the marine transportation system, especially in the implementation of the Indonesian maritime highway digitization system.

The method used to answer and discuss research variables uses the approach of observation, interviews, questionnaires, stakeholder opinion, and other supporting documents. This study uses the Quality Function Deployment (QFD) method. QFD digitizing in Teluk Lamong terminal service system is used to link the Customer Requirements (CR) and Performance Standards (PS) to identify relevant PSs that affect the effectiveness and efficiency of the port system to the specified CR. The QFD method has several stages of planning and development through a matrix, one of which is the product planning matrix (House of Quality). This study introduces a comprehensive approach to exploiting House Of Quality (HOQ) to link critical issues with customer requirements with standard operating procedures of seaport systems related to achieving customer requirements.

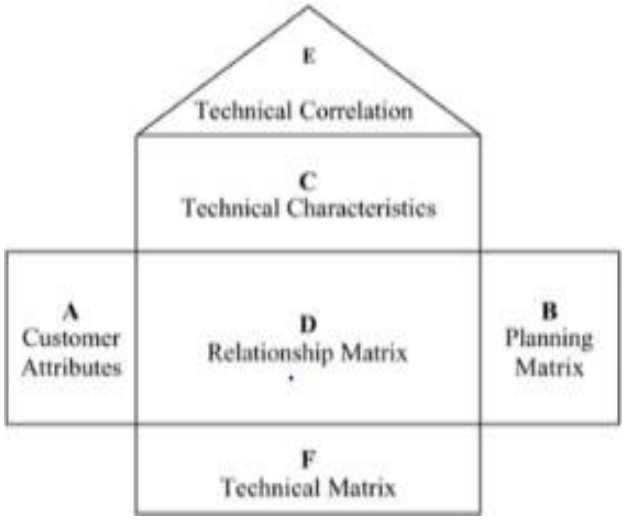

Figure 1. Framework Of QFD

Customer needs data were obtained from previous literature as well as from the aspirations and opinions of stakeholder expertsusing interview and questionnaire approaches. Then in determining the technical response variable in the HoQ, which is how to directly meet customer satisfaction, nine parameters of the port performance standard digitization system will be filled in based on the Indonesian Port Integration (Inaportnet) system.

RESULTS AND DISCUSSION

The QFD digitization of the lamong bay terminal service system is used to link the Customer Requirements (CR) and Performance Standards (PS) to identify relevant PSs affecting the effectiveness and efficiency of the port system to the specified CR. Therefore, CR appears as what's in the HOQ because first the port authority must identify and determine exactly what the customer needs, while PS appears as how it's because it will directly affect how to meet customer satisfaction (CR). Based on Kusuma's research (2020), by paying attention to aspirations and conducting interviews with stakeholder experts as stakeholders and through previous literature as obtained from the Pelindo report (2017), it can determine sub variables for customer data needs. The following is data from stakeholders as port stakeholders as shown in Table 2.

Table 2. Port Stakeholders

Stakeholder	***Organization***
Shipping/Logistics Company	*3 shipping companies*
Consumer Products Company	*2 consumer product companies*
Government	*Ministry and Local Government Representatives*
Port Authority	*Pelindo and Teluk Lamong Terminal*

House of Quality (HOQ)

The House of Quality is used to link critical issues with customer needs with standard operating procedures of the seaport system related to achieving customer requirements. Then for the next HOQ, the output of the standard operating procedures for the seaport system, in turn, is related to the process of digitizing the sea highway program system. This study uses only two steps of "House of Quality" (HOQs) in the QFD model.

HOQ links customer requirements and performance standards. There are four critical sub-variables from each of the main variables that are used as critical customer aspirations, namely logistics costs, dwelling time, distribution channels and cost of goods, and port operating costs. The technical response variable will be

filled with nine performance standards of digitization system parameters. Service performance indicators related to port services are shown in Table 3 below.

Table 3. Performance Standards for Digitalization Systems

Performance Standard	*Descriptions*
Updated Application Notifications	*Display timely notification or information*
Application usage procedure information	*Provide guidance and steps for using information system applications*
Convenience of visual interface	*The appearance of the application design is attractive and comfortable in the eyes of the user*
Person of Chat between Ports	*Between ports can communicate to exchange information directly*
Features detailed ship specification information	*Displays detailed details regarding the specifications of the ship that will operate*
Dock activity information feature	*Displays all ongoing activities at the harbor dock*
Ease of use of the application	*It is easy for users to access every feature it has.*
Application data security	*The confidentiality of data and information exchange is guaranteed*
System integration among stakeholders	*Port stakeholders can access service operational system data for their benefit according to procedures*

The results of data processing on the first HOQ are the first process stages, namely identifying the customer requirements (CRs). Furthermore, the process of determining the priority scale of the customer requirements, the critical variables of the customer requirements, and their rankings, as given by shipping companies and consumer products. Among all the sub-variables customer requirements, logistics costs, dwelling time, distribution channels and cost of goods, and port operating costs are the most important.

The next step is to determine the technical requirements (Technical Responses) based on references and preliminary interviews. Technical Responses are obtained from digitization system parameters. In the fourth step, a correlation matrix is designed using the average of the six data sets from the government and port authorities.

From the calculation of the House of Quality (HoQ) above, it can be analyzed that each technical response has a priority level so that it can be determined which attributes should be developed first. The technical response which is the first priority is system integration between stakeholders, this means that all stakeholders will be connected to each other on one platform so that the port operational system can run effectively and efficiently.

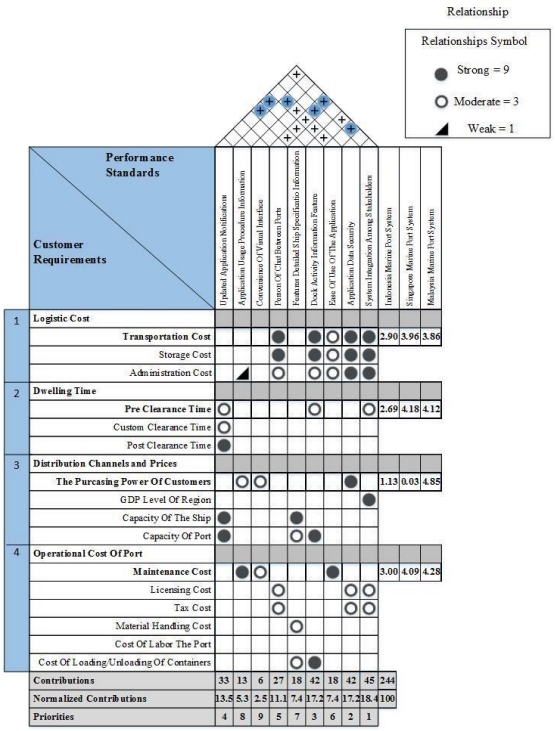

Figure 2. First HOQ Linking AHP Output and Performance Standard of Port Operation

The technical response to system integration between stakeholders has a strong relationship with the sub-variables of transportation costs, storage costs, administrative costs, and regional

GDP. From the sum of the weights on the technical response to system integration between stakeholders, it can be obtained that the contribution value is 45 and the normalized contribution is 18.4%.

Then the technical response which is the second priority is application data security, this means that a port service system digitization system must guarantee data security and its confidentiality in exchanging information between stakeholders and users. The technical response of application data security has a strong relationship with the sub-variables of transportation costs, storage costs, administrative costs, and consumer purchasing power. From the sum of the weights on the technical response of application data security, it can be obtained that the contribution value is 42 and the normalized contribution is 17.2%.

Furthermore, technical responses which is the third priority, namely the dock activity information feature, this means that a port service system digitization system needs to display all ongoing activities at the port dock, so that stakeholders can find out the density of dock activity only by using the platform. The technical response of the dock activity information feature has a strong positive correlation with the technical response of updated application notifications and has a positive correlation with the technical response of person of chat between ports, ease of use

of applications, and system integration between stakeholders. From the sum of the weights on the technical response of the dock activity information feature, it can be obtained that the contribution value is 42 and the normalized contribution is 17.2%.

Proposed Improvement

Based on the House of Quality (HoQ), in designing the digital marine highway platform, priority of technical responses were obtained, such as system integration between stakeholders, application data security, and information features of dock activities. So we realized and fulfilled the needs of stakeholders in the port operational system into an integrated application called Marine Highway Tech. The application of the Marine Highway Tech platform is one example of a practical application that we propose as a form of digitalization implementation in the marine transportation system.

This application serves to assist port service users, especially port stakeholders, namely shipping companies, consumer products, the government, and the Port Authority. Because the application can integrate every stakeholder, making it easier to carry out sea highway operations. In addition, digitally recorded data can provide information related to marine highway activities neatly and accurately. Information is provided about everything that happens during the process of shipping or unloading commodities with integration with the Google maps system. The Marine Highway Tech application also provides a feature for paying port service fees via m-banking. With the Marine Highway Tech application, everything can be done through one application.

Another impact that will arise with this application is that there will be many conflicts of interest with shipping agents who have built their conventional systems with port stakeholders. The practice of additional or illegal levies that have been covered up so far, will be greatly reduced by the online application system. The security system for this application is guaranteed with login access using a registered email and password. So that only stakeholders who play a role in the marine highway system can access and use this application.

Conclusion

Based on this research, it is possible to revitalize a new model for ports in optimizing services so that ports, especially Teluk Lamong Terminal, Surabaya Port, are effective and efficient. So that the digitization of the seaport service system can provide recommendations to be able to reduce logistics costs and be able to maintain the stability of the port, then several things need to be considered in digitizing the

service system for the current port, among others, First, with the digitization of the service system Seaports, it will help port service users, especially port stakeholders, namely shipping companies, consumer products, the government and the Port Authority.

Second, from the HoQ results obtained in the planning of the digital platform to the sea, three technical responses are prioritized, namely system integration between stakeholders, application data security, and information features of dock activities. From the results of the HoQ, namely the integration of all stakeholders, the system can synchronize faster between stakeholders so that it can solve problems effectively and efficiently. the dock activity feature, stakeholders can get information about seaports quickly.

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