

Supply Chain Resilience Analysis using the Quality Function Deployment (QFD) Approach in a Freight Forwarding Company

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Abstract

The increasing volume of Indonesian exports each year has made freight forwarders should properly maintain their service quality performance to survive in this competitive supply chain situation. PT. Schenker Petrolog Utama Surabaya is one of the freight forwarders who experience an issue where the increasing export volume was not supported by the increase in the shipper's reorder numbers. This study aims to determine the resilience measures that can be implemented by freight forwarding in overcoming maritime risks to meet the needs of shippers and improve service quality performance. The method used in this study is QFD with a two-step house of quality design, which involved 75 respondents from various company representatives who used Schenker's ocean freight export service from 2014 to 2019. The results identified the eighth-highest attributes of customer requirements with the five most influential maritime risks, and in the end, were equipped by the five-best resilience measures as the compatible solution. Several strategies to survive in the maritime supply chain are arranging appropriate qualifications and providing training to employees, expanding cooperation with vendors and shipping liners, making appropriate backup plans, maintaining good coordination between key players, also carrying out maintenance and update of the IT systems regularly.

Keywords: Supply chain resilience, maritime risks, customer requirements, QFD, and freight forwarding.

I. Introduction

The times that are increasingly advanced without any limitations have stimulated the movement of export activities in Indonesia. Based on recorded data of the Central Statistics Agency (*Badan Pusat Statistika*), the last update on January 3, 2020, the volume of national export activities had increased continuously from 2016-2018. It was consistent with the increasing volume of annual export containers at a freight forwarding company in Surabaya, Indonesia. Seeing the increasing and

dynamic pattern of customer needs, the ocean freight forwarders, as one of the export service providers, must follow this trend to avoid risks that will affect customer satisfaction. In the worst-case scenario, risks can also significantly influence the entire supply chain process.

When the supply chain is disrupted, its performance will be threatened in terms of profitability, namely the cost and inventory structure [1]. Not only does it threaten profitability, but supply chain disruption will also affect the overall service satisfaction level since forwarders are the key players in the supply chain of the maritime sector [2]. The instability causes of these services used do not only come from the internal party inside the freight forwarding company but also related to other external parties who take part in the process of sending export goods in the supply chain. For example, the ship's departure schedule is backward from the schedule listed on the shipping liner website. These are the example of accidents at sea such as burning ship, sinking [3], being shot, being hijacked [4], deviating from the route [5], and so on. Moreover, the risk of a labour strike at the port could hamper the export-import process due to the absence of activities at the port. The occurrence of natural disasters that cannot be predicted accurately can also disrupt the supply chain process, particularly in the maritime sector.

A reliable supply chain can assist the freight forwarders in surviving any possible risks that can harm the company in order to create excellent service quality. To create a unified supply chain from upstream to downstream within the scope of international trade, it is necessary to integrate between key players in order to create a resilient supply chain. Supply chain resilience is the ability of the supply chain to reinstate to its primary or more reliable state, after being affected by a disruption, and to avoid failure in the supply chain [6], especially in the maritime supply chain.

Therefore, to bring back and maintain the supply chain sustainability in freight forwarding companies, this study aims to determine the suitable resilience measures which can be implemented effectively to the current company's condition as an effort to provide better service performance. Further results will be analyzed through previous studies' results related and discussed with the company's stakeholders to assess its compatibility for future improvement. This study will expand the supply chain resilience literature in freight forwarding companies, particularly the ocean freight export business process, which is still infrequent and limited.

II. Methods

The flowchart in Figure 1 shows the step-by-step in conducting this study. This research is a typical case study done in one of the Indonesian freight forwarding companies. Delivering goods by the sea has been the most favourite pathway in sending customers' goods at the lowest price, yet quite fast. Thus, this study is focusing on the ocean freight export business process.

The primary data used in this study are collected through questionnaires aimed at the customers (shippers), as well as brainstorming activities and structured interviews with experts in positions of Manager and Supervisor at one of the freight forwarding companies in Surabaya, Indonesia, PT. Schenker Petrolog Utama. The QFD method used in this study is a two-step house of quality with three groups of attributes, they are customer requirements, maritime risks, and resilience measures. The first house of quality will identify the relationship between consumer needs and maritime risk. Meanwhile, the second house of quality is used to determine the relationship between maritime risk and resilience measures that forwarders can get in complex maritime supply chain processes. The construction stages of the two quality houses according to Lam and Bai [7] can be carried out as follows:

1) Identification of Customer Requirements (CR)

Conduct literature studies regarding customer need in maritime logistics and conduct brainstorming and interviews with industry professionals (experts) regarding customer needs.

2) Prioritizing Customer Requirements (CR)

Make a priority ranking of interests from the results of distributing questionnaires to customers, using a 4-score Likert scale. Followed by the calculation of the Weights in Equation 1 below:

$$W_i = \frac{I_i}{\sum_{i=1}^n I_i} \quad i = 1, \dots, n \quad (1)$$

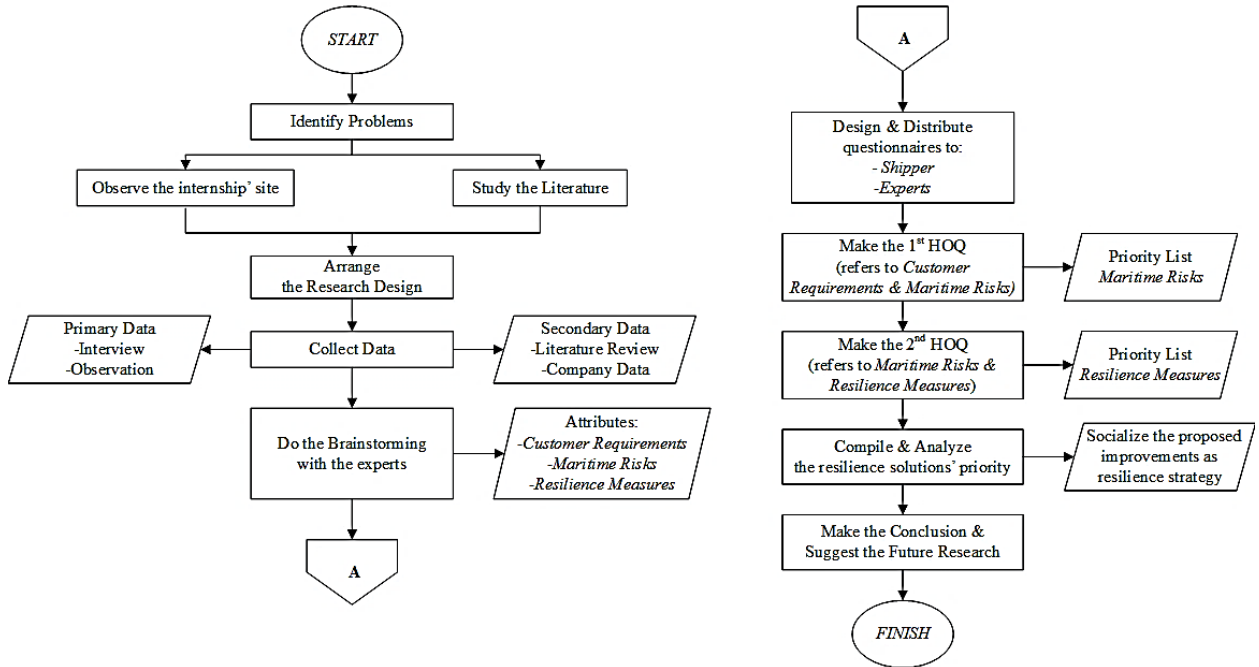


Figure 1: Research Methodology Flowchart

3) Identification and Assessment of Design Requirements (DR)

Conduct a literature study on the risks that exist in maritime logistics. In addition, it also conducted interviews with experts and assessed likelihood, impact, and effectiveness for potential risks using 1-4 scores of the Likert scale.

4) Determination of Technical Correlation

Determine the technical correlation between all “Hows” attributes (on the house of quality’s roof), by implementing symbols that identify the different relationships between the attributes. Relationship correlations consist of strong positive, positive, negative, and strong negative correlations.

5) Determination of the Relationship Matrix

The relationship that is assessed is the impact that the potential of the “Hows” attribute group can have on the “Whats” attribute group.

6) Assessment of the Technical Matrix

Calculate Absolute Importance (AI) as in Equation 2, and Relative Importance (RI) according to Equation 3 below.

$$AI_j = \sum_{i=1}^n W_i R_{ij} \quad j = 1, \dots, m \quad (2)$$

$$RI_j = \frac{AI_j}{\sum_{j=1}^m AI_j} \quad j = 1, \dots, m \quad (3)$$

III. Results and Discussion

A) First House of Quality

In an effort to improve the quality of freight forwarding services, it is necessary to have a quality dimension for these services to determine the interests and needs of consumers as the main users.

Therefore, we need a list of quality dimensions to build the “Whats” section of the first house of quality as shown in Table 1, accompanied by its weight of importance.

From Table 1, the results show that the on-time delivery attribute has the highest value of importance along with the shipment attribute sent according to destination. The attribute of on-time delivery also has high importance, specifically 5 (1-5 scale), in the study conducted by Lam and Bai [7] with a similar research topic in the shipping liner industry, as well as in research based on Saraswati et al. [2] with topics and research objects similar to this current study. Delivery to the right destination, as well as accuracy in the creation and provision of the bill of lading (B/L) documents, are the essential support for the service performance of freight forwarding companies [8]. Loss and damaged records can also affect the shipper's assessment of the delivery service performance of the goods. Based on the results of a study conducted by Xu [9], the attribute of fast service, which is included in the dimension of “personnel service quality”, is also a significant factor in determining service quality. Meanwhile, the loading-unloading process, which is in the "reliability" dimension group, is also the most important factor according to customers in an effort to achieve satisfaction, based on research conducted by Bottani and Rizzi [10]. Customers will also feel appreciated if the forwarder can help them when issues arise in the delivery process [11]. Moreover, when they also give their best solution in handling those issues.

Table 1: Customer Requirements Attributes

N o	Attributes	Relative Weight	Rank
1	On-time delivery	12.86	1
2	Shipment's delivered to the right destination	12.86	1
3	Complete & suitable documents	12.81	2
4	Timely documents procurement	12.33	3
5	No goods were lost at the port/warehouse	12.33	3
6	Fast service	12.29	4
7	The smoothness of the loading-unloading process	12.29	4
8	The company always offers the best solution	12.24	5

The maritime risks which are selected as the cause of the problem, as well as composing the "Hows" section, are then correlated with one another so that they can fill the ceiling and roof of the house. After the “Whats” and “Hows” sections are filled, then a relationship matrix is arranged to determine the relationship between the two attribute groups, as the middle part of the house of quality. Furthermore, the calculation of absolute and relative importance is carried out for compiling the base of HOQ 1 as shown in Figure 2, with the yellow-coloured box as the five-highest ranking of importance rate.

The first of the top five maritime risks that must be prioritized according to Figure 2, with a score of 10.39, is the risk of the Customs Clearance process. The internal experts of the case company have admitted that this risk has been very influential in the activity of export goods delivery services. The assessment of the importance per attribute has shown that this risk has the highest total value with an average amount of 3.33 out of 4.00. The differences in customs regulations and operational procedures abroad are still counted as a major risk in the global shipping goods process [12]. Besides, the lack of responsiveness of the Customs in handling the export-import documents by sea can also result in serious effects within the process of goods shipping abroad. As the results of research conducted by Tseng et al. [13], when the staff of the transportation service does not complete the customs duties commensurate with the proper instructions, the process of goods delivery will not run smoothly, the worst case is, the goods will not reach to the consignee within the specified time. In the study conducted by Saraswati et al. [2], it was obtained that the risk of delays in handling documents by Customs was ranked in the top five most affected risks in a freight forwarding

company.

As for the second rank, with a relative weight score of 9.74, the experts stated that the uncertainty of ship schedules had a big effect in affecting overall customer satisfaction. Supply chain risks can be derived from a less flexible scheduling and routing process, which can cause operational problems and result in delays of the goods delivery [14]. This statement is supported by Arif [11], who found the results in his research related to customer perception of the service quality in one of the freight forwarding companies in Bangladesh, that customers feel dissatisfied when the delivery of goods is delayed, and unfortunately, they tend to do not want to understand the cause of it.

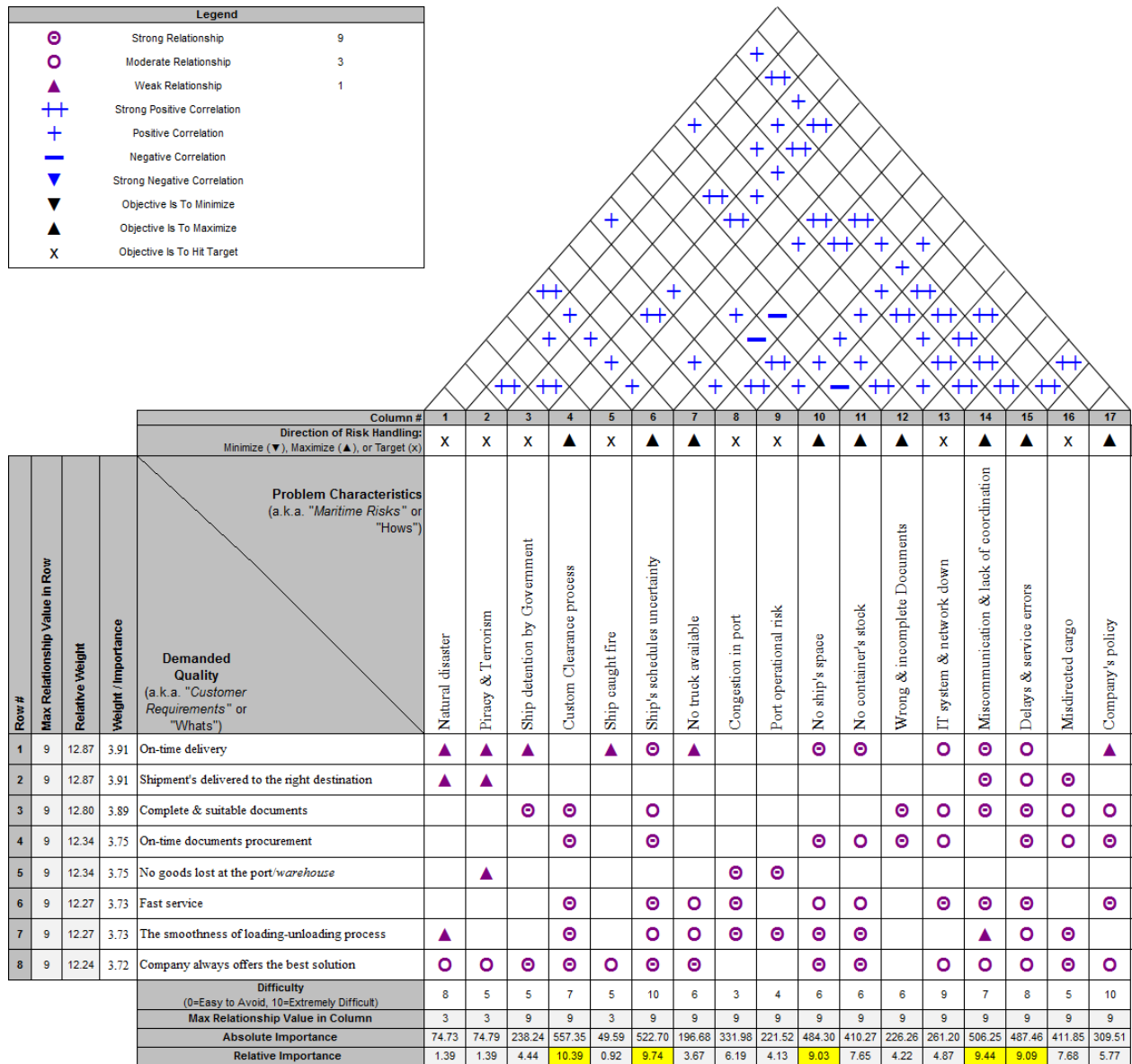


Figure 2: House of Quality 1

A study related to supply chain risk management highlights the collaborative aspects involving all key players, which can reduce vulnerabilities in the entirety of the supply chain [15]. On the contrary, Lam [5] argued that the cause of the increasing number of risks in maritime supply chains is the small, or even lack of coordination between key players, which causes miscommunication and other risks in the process of shipping goods from shippers to consignees. Poor communication and coordination between key players in maritime supply chain activities can have fatal consequences like the wrong destination of the delivery, which make the goods do not reach the hands of the

consignee, as the recipient. The worst-case scenario is when the customers feel disappointed, they might cut off subscriptions.

In Table 2, it can be seen that the fourth place, with a relative weight score of 9.09, is the attribute "delay and service error". This risk is closely related to resource management, which is the ability of employees to serve the document needed by the customer promptly. According to the results of the ranking of customer requirements shows in Table 1, the rank of both attributes is in the second and third respectively, which indicates that it is important for employees to not make any mistakes and create a delay in the process of providing the export documents for shippers. In line with the results of the top eight customer requirements attributes in Table 1 in this study, delays and errors in the service process can significantly affect customer satisfaction. If the document is wrong or delivered over what has been promised, the goods cannot get into the port and to the container. Therefore, customer relationship management is an important element of the supply chain and logistics, to reduce the risk of such service errors [14].

Table 2: Maritime Risks Attributes

No	Attributes	Relative Weight/Importance	Rank
1	Custom Clearance process	10.39	1
2	Ship's schedules uncertainty	9.74	2
3	Miscommunication & lack of coordination	9.44	3
4	Delay & service errors	9.09	4
5	No ship's space	9.03	5

There is no space left in the ship, with a score of 9.03, has been identified as the fifth risk which going to influence the maritime supply chain of the ocean freight export scheme. One of the experts from the internal case company stated that the risks that have a major impact in influencing the shipper's assessment of the freight forwarding company's performance are the cargo space confirmation from the liner and the freight charges changes during the erratic turn of the month. The unavailability of space means that the transportation facilities to be used for freight delivery to the destination on the selected schedule are not currently available. Transportation availability is a critical factor that can influence maritime freight management decisions, apart from the type and characteristics of freight management, origin, and destination, also the cargo packaging systems [16]. Subhashini and Preetha [17] found a rating result where the availability of cargo space, which is included in the reliability dimension, ranked first on the determination of service quality factors in the ocean freight forwarding business scheme. This means that if there is a problem in providing cargo space on the ship that takes longer to be handled, the longer the goods delivery process will run. Thus, customers will feel harmed, which in the end, can make them become sick of the service performed within the forwarding company and decide not to repeat to use their service again. Besides, this unavailability of cargo space will also lead to delay in delivery [13]. This risk is not the most harmful one, yet the company should still take this risk into account.

B) Second House of Quality

The arrangement of "Whats" in the second house of quality is taken from the maritime risk attribute which was previously used as "Hows" in HOQ 1, complete with their absolute value and relative importance. Meanwhile, the "Hows" section of the second house of quality is compiled from a group of attributes of resilience measures. Using the same stages as the construction of the second house of quality, the final result of the second house of quality is obtained as shown in Figure 3.

From the second HOQ, it can be seen that there is a total of 12 solutions derived from other similar literature which are being cross-checked and discussed with the internal experts of the case company since its business process is unique. However, this study only thoroughly discusses the five best solutions to meet the compatible resiliency within the ocean freight export supply chain, as shown

in Table 3. These five resilience measures are also being highlighted in a yellow-coloured box in Figure 3. These five attributes are expected to minimize and eliminate the maritime risks that appear unpredictably, to help the ocean freight export business process to survive in complex maritime supply chain activities.

The first highest resilience measure is the labour's qualification skills. Its relative importance score is 15.31, which indicates that this attribute is highly recommended to be improved immediately. Based on the research carried out by Berle et al. [18], it is mentioned that the resilience of a third-party logistics company (freight forwarding) can be improved by the flexibility of the company in its operational activities, one of which is by the presence of a workforce that has more than one skill (multi-skills). The internal practitioners advise companies to provide certification programs, preventive education, and other programs for employees to develop their capabilities because according to Buyukozkan and Gizem [19], employees are the main resources that must be developed first.

Labor's skill qualifications have an explanation that the company must improve and determine the best qualifications for employee-specific abilities that will communicate directly with customers. One of the examples is employees who work as customer service staff, which required interpersonal skills to communicate with two or more people, such as in negotiation activities, cooperation, and so forth. In the process of interpersonal communication that requires the interlocutor, employees are required to be able to send, understand, and receive messages delivered by the interlocutor, which not every human being is able to do so. Therefore, in the process of employee procurement for the customer service section, the company needs to establish the right qualifications from appropriate candidates to support the service performance in order to obtain a high level of customer satisfaction. In the survey that has been conducted to experts from the internal case company, it was obtained that the capabilities of employees are very important in efforts to increase the resilience of freight forwarding business with the relative importance score of 3.67, from a maximum scale of 4.00.

Table 3: Resilience Measures Attributes

No	Attributes	Relative weight	Rank
1	Labor's qualification skills	15.31	1
2	Cooperation with vendor & shipping liner	14.40	2
3	Backup plan	12.73	3
4	Key players coordination	9.11	4
5	Advanced IT system (real-time tracking)	8.19	5

Resilience measures attribute with the second-highest score of relative importance in 14.40 is the "cooperation with vendors & shipping liners". Vendors in this study refer to the truck and warehouse rental companies' representatives. This attribute is considered important, because it concerns the smoothness of the initial process in the supply chain from shipper to consignee, before transporting it abroad by ship. If the forwarding company only cooperates with both one vendor and shipping liner locally, when they run out of trucks stock, have full warehouse capacity, run out of container and ship space, or even abruptly stop their business, then inevitably, the forwarder has to immediately find another company to transport their goods. As a result, more and more time will be wasted in looking for other suitable companies. Furthermore, due to the limitations of facilities and infrastructure, not all vendors and shipping liners can meet every need of the forwarding company.

Therefore, sea freight forwarding companies need to cooperate with more than one vendor and shipping liners, in order to have a smooth supply chain. Huang et al. [20] found the high importance level of "service points and networks" to achieve customer satisfaction and avoid risks that can affect the forwarding's performance. Thus, companies are advised to expand their scope of services and

networks through partnerships with major operators and local logistics service providers. In the case of ocean freight forwarding, it requires cooperation with shipping liners and truck rental companies massively and globally, yet the forwarder also has to consider the distance to avoid overspending time. Besides, it is important for freight forwarders to conduct supervision and maintenance of their performances, to sustain the smooth supply chain and avoid any possible risks in the future [19]. In addition to supervision, the company needs to determine the right type of vessel according to the size, equipment, and certification needed for various types of cargo, to avoid vessel failure mode [18]. If there is no continuous monitoring and relying solely on trust, when suddenly their performance is out of control, the impact will arise afterwards and will also harm the forwarder itself.

The backup plan is determined as the third-best solution in reaching ocean freight forwarder's supply chain resilience. To avoid problems that may occur in the maritime supply chain, the manager, as the executive in charge of the division underneath, must play an active role in planning and preparation [21]. The manager needs information from employees in his circle who are directly involved in every stage of service in the field. Information collection can be done through regular communication, thus creating alternative planning that is on target, which can later be implemented by the company to maintain the activities of the maritime supply chain that has been running. It is suggested to make preparation and planning at all major risks that had been identified earlier through the help of overall evaluation [22], [18]. With the creation of backup plans, it means that the company has taken preventive measures to maintain the sustainability of its business before those risks can harm the company's situation.

Lack of coordination can lead to errors in the document interpretation process, therefore, by managing regular communications with maritime supply chain key players, such risks can be reduced [7]. Maritime risk management can be done by carrying out friendly supply chain activities through collaboration with all relevant parties [5]. Following the results in Table 3, with a relative importance score of 9.11, coordination between key players (freight forwarders, shipping liners, port/terminal operators, and Customs) needs to be done by the company as a resilience solution to the overall maritime supply chain. Visibility also becomes very important in building supply chain resilience [23]. Without transparency of information in supply chain activities, disruptions will arise, which leads to failure in reaching the goals. When a risk arises at one stage in the supply chain process, the consequences will spread to other stages, like the domino effect. Therefore, with the collaboration between key players, the supply chain relationship will develop and become more sustainable.

The resilience measures attribute in the fifth rank, with a score of 8.22, is "real-time tracking". In an earlier study, Lu [24] suggested implementing a tactical knowledge-based scheduling system for forwarding companies to support the scheduling process of delivery plans. The provision of real-time control is also a key step [25] for freight forwarding companies in expanding load consolidation, reducing empty vehicle travel, and addressing dynamic disruptions. In 2014, Schenker began to build its information system, it is varied from a system to create a more structured and easily-filled document, a system for tracking employee attendance and performance, and a special website made for customers to track their shipments in real-time. On this website named "*Trackingmore*", customers can check the status of their shipments just by entering the tracking number, then click "search", then they will get the latest real-time location of the goods. Moreover, it has also provided a form that can be filled by customers who want to convey their testimony and complaints to the services that have been provided by the company in any mode of transportation. Nevertheless, not all systems can work properly at any time. The EDI (Electronic Data Interchange) systems, which are commonly used in the process of disseminating information between several companies, do not always show better results for the company's performance [26]. Therefore, particularly in this study, the real-time tracking system has not been the best choice of solutions that must be rushed in implementation by the company in the short-term improvement process, yet it is still prioritized as the five-best

rankings out of 12 resilience measures that have been proposed.

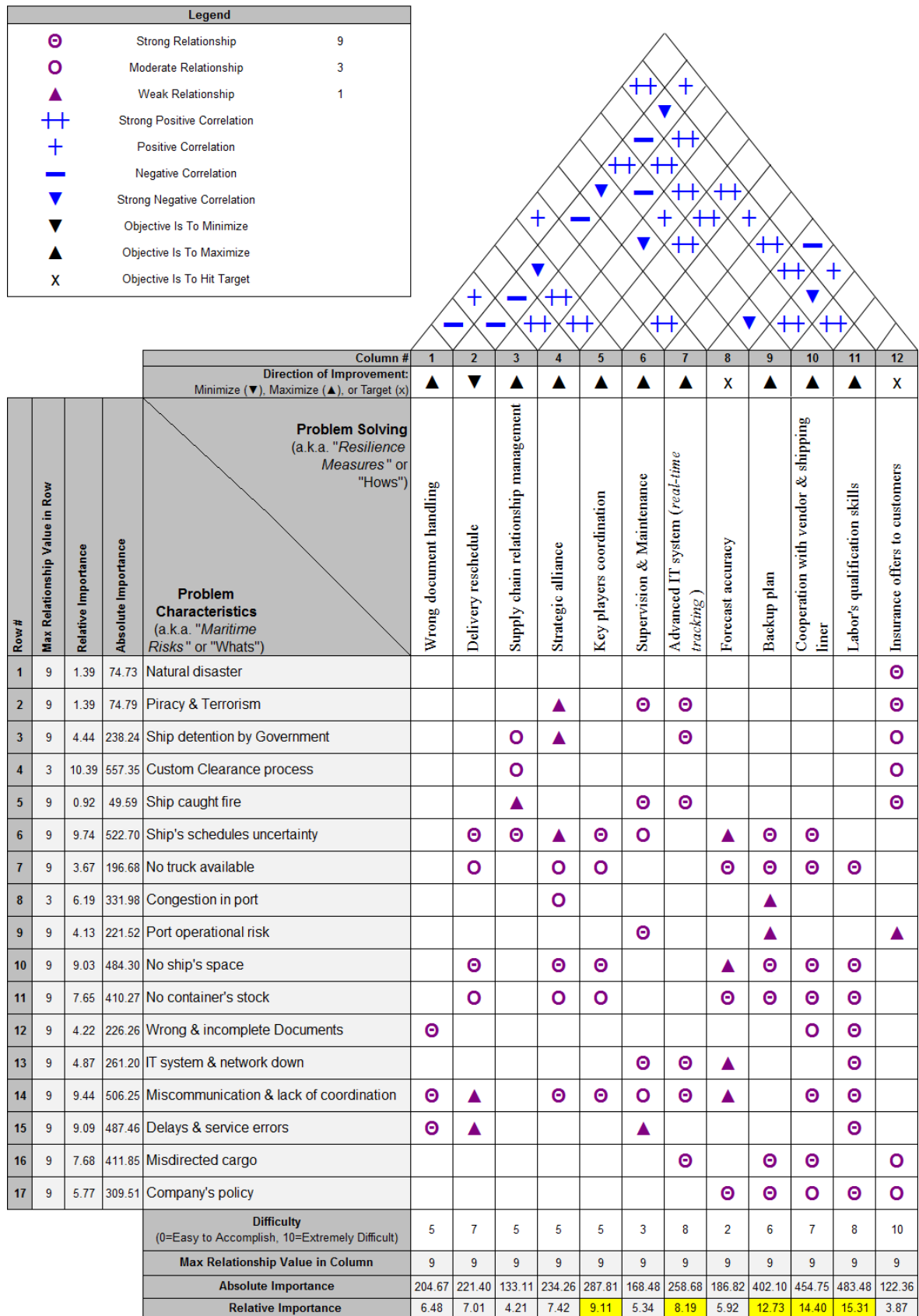


Figure 3: House of Quality 2

Based on the experts, improving the information and technology (IT) system based on real-time tracking will make it easier for customers to confirm the location of their shipments in "real-time", i.e., the actual location at the specified time. It can also lighten the employees' duty in the freight forwarding company since it will avoid excessive contact and questions from customers who want to confirm the position of their shipments continuously. Therefore, the company must carry out continuous development on the website to make it more user-friendly [8]. Furthermore, maintenance and regular updates to the information system need to be done by the company to achieve competitive services globally.

IV. Implications

This study has substantially contributed to both theoretical and practical implications. Since there is limited literature that focuses on the freight forwarding case, this study will build on updated literature on this field. In addition, this case study was conducted in one of the countries which prioritize freight delivery through the ocean by utilizing ships. Therefore, this study is applicable for any other forwarders who deliver their freight using ships. As for the practical implication, understanding the results of this research will help managers from related companies with similar risks in searching for any other substitute solutions to maintain their supply chain resiliency, most importantly in the maritime scope. In this case, if certain risk strikes, the company will be ready to take the right action. Not only does this paper provide some actual risks in the maritime supply chain, but it also will help freight forwarding companies in achieving their customer needs. By knowing the customer's needs, freight forwarding companies will create high value in delivering the best service to their customers.

V. Conclusion

Freight forwarding companies, as distributors in the process of moving goods from sender to recipient, have the responsibility for the delivery of the goods properly, safely, and quickly. Shipper, as a user in the process of shipping export goods, has several points to determine which freight forwarding company meets the requirements. Some of the identification points that are considered very important by the shipper are on-time delivery, delivery of shipments to the right destination, complete documents as needed, provision of documents on time, never lost goods at the port or warehouse, fast service, smooth loading-unloading process, and the company that always offers the best solution for the occurred problems.

The risks that can disrupt the customer satisfaction of the freight forwarding company come from three different categories, such as the internal business operations (included all the possible internal sources whether from the people, service, or system), the external environment (included unexpected third party and natural phenomenon), and lastly is any possible issues come from within the whole maritime supply chain process which engages other recognized third parties. While the top five risks which going to highly affect the freight forwarder's business process are the customs clearance process, the uncertainty of ship schedules, miscommunication and lack of coordination, delays and errors in service, also not getting any ship spaces.

Not all risks can be dodged or even eliminated, consequently, the company needs to forecast and predict any risks that may harm the overall company's service performance by making immediate actions. The five resilience measures found in this study to minimize the maritime risks are included fulfilling the qualifications of human resources skills, expanding cooperation with

vendors and shipping liners, creating appropriate backup plans, maintaining good coordination between key players, and frequently developing real-time tracking systems.

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