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## Maritime Container Terminal Service Quality in the Face of COVID-19 Outbreak: Forwarders' View

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**Abstract:**

**Purpose:** The study aims to determine and evaluate the mutual relation between price and selected factors of service quality of the maritime container terminal. Moreover, the forwarders' view of the change of the service quality and price level in the major polish container terminals during COVID-19 has been taken under consideration, as well as the forwarders' enterprises situation during the ongoing pandemic.

**Methodology:** A few research methods were applied: literature review, questionnaire method, DEAMTEL, comparative analysis.

**Findings:** Research revealed the relation between quickness of the service, security, and price aspects. The quickness of the service has been identified as an effect, while security and price factors have been identified as a cause. The ongoing pandemic caused a decrease in the quickness of the service and a slight increase in price in the examined maritime container terminals. Forwarders that took part in the study, have increased their market share through an increase in the number of orders.

**Practical implications:** The results of the study could be considered as an interesting source of information for maritime container terminal operators and freight forwarders.

**Originality:** This research is the first that attempted to determine the mutual relation between various factors of service quality and price at the maritime container terminal. Moreover, the study presents the change of the forwarders' situation during the COVID-19.

**Keywords:** Service quality, container terminals, COVID-19, freight forwarders, DEMATEL.

**JEL classification:** L15, M16, R49.

**Paper type:** Research paper.

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## 1. Introduction

During the COVID-19 pandemic, transport activity has suffered significantly, especially during the first lockdowns and travel restrictions. These situations had an impact on global trade, which has fallen by 5% in the first quarter of 2020, and by 27% in the second quarter (UNCTAD, 2020). Worldwide ports were confronted with a significant decrease in cargo volumes and vessel calls (Notteboom *et al.*, 2021). The impact of the current crisis on ports varied dependent on various elements such as e.g.: cargo mix of the terminal, and position in the global supply chains, although practically all major ports suffered (Charłampowicz, 2021).

The busiest container port in the world, located in Shanghai, has noted a slight increase of 0,4% of TEU handled in 2020 compared to 2019. On the other hand, the second busiest port, in Singapore, has noted a decrease of TEU handled by 0,9% yearly. The busiest European port, the port of Rotterdam, which is the only non-Asian port listed in the top 10 busiest ports in the world, noted a significant drop of 3,2%.

The competitive advantage of the maritime container terminal is connected with many elements which are directly or indirectly connected to the terminal, one of the aspects which can be developed and managed by the terminals' authorities is service quality (Charłampowicz, 2020). Other aspects of competitiveness are e.g.: location, maritime access, and customs (Kaliszewski *et al.*, 2020). The problem of service quality in the maritime container terminal is a complex and important one, although in the literature little space has been devoted to it. Unfortunately, there is no empirical research dedicated to the mutual relation between various service quality factors in the maritime container terminal (Charłampowicz, 2020). Moreover, it is important to examine the impact of COVID-19 on the terminals' customers, like freight forwarders.

The purpose of this paper is twofold: first to determine the mutual relation between price and selected service quality factors. The second aim of this paper is to examine the change of the major polish maritime container terminals service quality during the current crisis from the forwarders' point of view.

## 2. Brief Characteristics of the Maritime Container Terminal Service Quality

The maritime container terminal service quality is an important problem, which has been raised by many researchers (Hemalatha *et al.*, 2018; Thai, 2008; Yeo *et al.*, 2015). Even though some aspects have been neglected (Charłampowicz, 2020), such as the mutual relation between various quality criteria. The main criteria of the service quality are, based on the literature, quickness of the service, availability, security, reliability, commonness, and environmental issues (Kaliszewski *et al.*, 2020).

A different point of view has been proposed by (Thai, 2008), in which the author proposed the ROMPIS model, in which the main service quality criteria are: resource-related, outcome-related, process-related, management-related, reputation-related, and social responsibility-related. The majority of the most important (in the context of annual TEU throughput) maritime container terminals are operated by one of the three groups of owners – shipping lines, container operators, or financial institutions (Charlampowicz, 2019; Notteboom and Rodrigue, 2012).

Moreover the maritime container terminal is a very complex, yet homogenous entity, in which most processes, resources (e.g., superstructure and infrastructure) and outcomes are similar to other terminals in the world (Mańkowski and Charlampowicz, 2021).

The reliability, availability, and commonness of the service are also very similar in the world – all terminals need to meet the requirements for being available and reliable. Most of the major terminals are part of the bigger capital groups, therefore, all processes should be controlled and measured. Therefore, it is possible to highlight few competitive factors directly dependent, developed, and managed by the terminals' authority. First is the price of the proposed services, this price can be expressed in various forms included in the tariff.

Some price aspects, such as e.g., THC are paid directly by the shipping lines, while others are dedicated directly to the forwarders. The price has to correlate with other important aspects of the terminal itself, such as e.g., location in the global supply chain, geographic location, infrastructure, nautical access, etc. Price should be correlated with perceived service quality, although in some sectors it has been found that service quality has a higher power as compared to price in predicting customer satisfaction (Shen and Yahya, 2021).

Other aspects of the maritime container terminal competitive factors directly dependent, developed, and managed by the terminals' authority are connected with the service quality and are namely: security and quickness of the service. Even though there are requirements for the security and safety of the load, the local regulation can make it more restricted.

Therefore, this aspect of service quality can be different in various regions of the world. The quickness of the service is a major factor of time efficiency, which is an important aspect of supply chain efficiency (Charlampowicz, 2018; Charlampowicz and Mańkowski, 2020). Moreover, due to the importance of the time factor, the quickness of the service can be perceived as a tangible indicator of the price.

In the literature dedicated to maritime container terminals, there is little space devoted to the mutual relation between various criteria of service quality and price. To properly evaluate this relation between presented factors of competitiveness it is important to implement a suitable research method.

### 3. Methodology - DEMATEL Method

The DEMATEL method has been used for the construction of the cause-effect chain and the analysis of its components. This method is capable of illustrating the overall influence of factors (Wang and Tzeng, 2012), visualizing causal relations (Liaw *et al.*, 2011), and analyzing dependent factors (Liou *et al.*, 2008). The implementation of DEMATEL method can be divided into few steps (Shafiee *et al.*, 2014):

Determines the direct relation between the considered factors. The relations between elements will be judged by professionals subjectively using a questionnaire design, formed by comparing criteria of each element pair which is shown by numbers from 0 (no influence) to 4 (extreme influence). Based on the pairwise comparison set up a direct-relation  $n \times n$  matrix, where the main diagonal elements equal 0. Figures inside matrix  $Z$  show the influential extent between the elements. Computes the normalized direct-relations matrix and standardized direct-relation matrix  $X$  – the results obtained in the matrix are an average of expert opinions.

$$X = S \times Z,$$

where:

$X$  – standardized matrix of direct relationships,

$$S = \frac{1}{\text{Max}_{1 \leq i \leq n} \sum_{j=1}^n z_{ij}},$$

$Z$  – matrix of direct relationships.

Another step is to calculate the total impact matrix (direct and indirect) – the following formula 3 is used to determine the matrix:

$$T = X(I - X)^{-1},$$

where:

$T$  – total impact matrix (direct and indirect),

$X$  – standardized matrix of direct relationship,

$I$  – unit matrix

Based on the significance indicator (formula 4) and the relation indicator (formula 5) draw the causal diagram.

$$S_{ij} = D_{ij} + C_{ij} = \sum_{j=1}^n t_{ij} + \sum_{j=1}^n t_{ij}$$

$$R_{ij} = D_{ij} - C_{ij} = \sum_{j=1}^n t_{ij} - \sum_{j=1}^n t_{ij}$$

where:

$S_{ij}$  – the significance indicator,

$R_{ij}$  – the relation indicator,

$D_{ij}$  – total amount of each row,

$C_{ij}$  – total amount of each column,

$t_{ij}$  – total (direct and indirect) influence from indicator  $I_i$  to indicator  $I_j$ ,

$n$  – number of indicators.

The causal diagram uses (D + R, D – R) as ordered pairs. The horizontal axis is dedicated to the significance indicator, while the vertical axis is dedicated to the relation indicator. Elements located above the horizontal axis are the cause, while elements below the horizontal axis are the effect in the cause-effect chart. Therefore, this method allows presenting causality of the elements as a simple and clear structure (Shafiee *et al.*, 2014).

#### 4. Data Collection and Study Design

Participants of the research were selected from the Polish International Freight Forwarders Association, an organization with more than 160 members. The questionnaire has been sent to all members of the organization. During the first round of sending the questionnaires, in July and August of 2021, 4 participants returned the filled questionnaires. During the second round in mid-August and October, 18 participants answered. In total 22 enterprises took part in the study.

Participants of the study were asked to answer questions concerning three polish container terminals in the context of two matters. First was dedicated to the mutual relation between three selected competitive factors, quickness of the service (factor  $f1$ ), security (factor  $f2$ ), and price (factor  $f3$ ). The quickness of the service is connected with any type of service that the forwarder receives from the terminal. The security is connected with all aspects of safety and security of the load, vehicles, and human resources. The price is connected with the fee for any received service. The second part was connected with the impact of the current COVID-19 crisis on the polish maritime container terminal service quality and situation in forwarders' enterprises.

The names of the container terminal operators are: CT1, CT2 and CT3. The salient features of container terminal operators are shown in table 1. CT1 has handling capacity of 1,2m TEU, the CT2 has capacity of 0,63 m TEU, and the CT3 has capacity of 3,25m TEU.

### 5. Research Results

The results of the normalized direct-relation matrix  $X$  three selected competitive factors: quickness of the service (factor  $f1$ ), security (factor  $f2$ ), and price (factor  $f3$ ) are shown in Table 1.

**Table 1.** Normalized direct-relation matrix  $X$  for service quality and price factors.

	$f1$	$f2$	$f3$
$f1$	0	0,4267	0,5467
$f2$	0,5733	0	0,3067
$f3$	0,6267	0,3733	0

*Source: own study*

The total impact matrix  $T$ , the significance indicator, and the relation indicator are presented in Table 2. The threshold value  $\alpha$  is **6,9099**, therefore all values of factors, which are greater than the threshold value, are bolded.

**Table 2.** Total impact matrix  $T$ , significance indicator, relation indicator

	$f1$	$f2$	$f3$	$D_i$	$C_i$	$D_i+C_i$	$D_i-C_i$	Identification
$f1$	<b>7,9171</b>	6,3517	6,8226	21,0915	24,0919	45,1834	-3,0004	Effect
$f2$	<b>7,7087</b>	5,6203	6,2443	19,5734	18,4240	37,9974	1,1493	Cause
$f3$	<b>8,4660</b>	6,4520	6,6067	21,5247	19,6736	41,1983	1,8511	cause

*Source: Own study.*

The impact-relation map, which presents the causal relationship between factors, is presented in Figure 1. Elements located above the horizontal axis are the cause, while elements below the horizontal axis are the effect in the cause-effect chart.

Table 3 presents the results of the study concerning the importance of the service quality and price factors among three major maritime container terminals, changes in service quality and price during the COVID-19 pandemic, the relation between container import contracts and export contracts, change of orders during the pandemic and size of the enterprise.

The answers for questions no. 1 and 2 were given on a scale from 0 to 5, where 0 always stands for “not using the selected terminal”, therefore it was excluded from the final analysis. In questions 1.1, 1.2, 1.3 value 1 stands for definitely not important, while 5 means definitely important. In questions 2.1, 2.2, 2.3 mark 1 stands for a significant drop, while 5 means a significant increase. In questions 2.4 and 2.6 mark 1 stands for definitely unsatisfactory, while 5 stands for definitely

satisfactory. In question 2.5 the scale was as follow: 1 – less than 1% of orders, 2 – from 1% to 5%, 3 – from 5% to 10%, 4 – from 10% to 15%, 5 – more than 15% of all orders.

**Figure 1.** Causal-effect relation diagram of various factors of service quality and price



**Source:** Own calculation.

On average the most important factor for forwarders is the quickness of the service, following security and price. During the COVID-19 pandemic on average the quickness of the service has dropped, while security has slightly increased. On average the price also slightly increased.

Most of the examined enterprises are specializing in container import contracts, moreover, most of the forwarders have noted growth of the orders during the pandemic. A significant drop in orders has been noted in the small enterprise (employing less than 10 people) specialized in import contracts.

**Table 3.** Forwarders' view concerning service quality and price factors and the COVID-19 impact on maritime container terminals and their enterprise situation

1. Importance of the service quality and price factors			
	CT1	CT2	CT3
1.1 Quickness of the service	4,4647	4,3114	4,4744
1.2 Security	4,3974	4,2234	4,3974
1.3 Price	4,1891	3,9634	4,3237
2. Changes in the service quality and price factors during COVID-19			
	CT1	CT2	CT3
2.1 Quickness of the service	2,4936	2,6703	2,7821
2.2 Security	3,4647	3,4615	3,4647
2.3 Price	3,6635	3,3223	3,6923
2.4 Efficiency of the customs clearance system	3,4744	2,7404	4,5064

2.5 Frequency of use of terminals in relation to all orders	4,3846	2,8045	4,8077
2.6 Evaluation of the THC rates, rebates, and other financial incentives	3,5801	2,9263	2,7340
3. Relation between import contracts to export contracts			
Imports dominates over 60 %	36,36%		
Imports dominates from 40% to 60%	18,18%		
Imports dominates from 20% to 40%	18,18%		
Imports dominates up to 20 %	13,64%		
Exports dominates up to 20%	4,55%		
Exports dominates from 20% to 40%	9,09%		
4. Average change of the orders during COVID-19			
Significant drop by more than 20%	9,09%		
Drop from 10% to 20%	9,09%		
Drop up to 10%	13,64%		
Increase up to 10%	31,82%		
Increase from 10% to 20%	13,64%		
Increase more than 20%	22,73%		

*Source: Own calculation.*

## 6. Discussion and Conclusions

The purpose of this paper was twofold, first to determine the mutual relation between price and selected service quality factors. The second aim of this paper was to examine the change of the major polish maritime container terminals service quality during the current crisis from the forwarders' point of view.

Based on the calculation it can be stated that the mutual relation between factors of service quality and price is as follows: quickness of the service can be considered as an effect, while security and price can be considered as a cause. Therefore, improvement of the quickness of the service should be considered as the priority.

The quickness of the service has been selected as the most important aspect of containers' service quality. The comparison between the importance of the factors of service quality and price and their change during the COVID-19 pandemic can be stated that, in general, the quickness of the service has dropped, which is a negative result, especially in the face of the highest importance of this factor.

Majority of the examined forwarders have noted the growth of the orders during the COVID-19 pandemic, even though the ports had to face a decrease in total cargo traffic volume (Charłampowicz, 2021). Even though the financial aspects of CT3 were evaluated as not satisfactory this terminal was the most frequently used.

During the ongoing pandemic, the maritime industry proofed its resilience. Even though almost every sector of this industry suffered, the negative impact of COVID-19 is various based on the cargo-mix, place in the supply chain, and size of the enterprise.

The study was dedicated to examining the view of the forwarders concerning the maritime container terminal service quality in the face of the COVID-19 outbreak. In conclusion, it can be stated that:

- The quickness of the service can be considered as an effect, while security and price can be considered as a cause.
- In general, enterprises that took part in the study have increased their market share through an increase in the number of orders.
- COVID-19 caused a decrease in the quickness of service and a slight increase in the price and security in the examined maritime container terminals.

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