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Article

Exploring service quality of inland container depot-empirical evidence from the Red River Delta, Vietnam

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Abstract: Inland Container Depots (ICDs) are inland multi-modal terminals where goods in intermodal loading units can be transferred directly to seaports. The contribution of ICDs to regions' economic and social growth is undeniable. To achieve the sustainable development of ICDs, evaluating and improving their service quality is critical. This study aims to investigate the factors contributing to the service quality of ICD in a developing country. The data utilized covers some ICDs in the Red River Delta, Vietnam. Regarding analytic methods, descriptive statistics first were run to show the level of aspects of service quality of ICDs. Subsequently, attitudinal statements were analyzed using exploratory factor analysis before linear regression was applied to recognize the factors influencing the service quality of ICDs. Generally, the service quality of ICDs was evaluated at an acceptable level but far from the high one. The results suggested that the four influential service quality factors included location and accessibility, facilities, process and management, and labor. Based on the findings of contributing factors, managerial implications were proposed.

Keywords: inland container depots; ICDs; service quality; logistics; Vietnam; accessibility

1. Introduction

Inland Container Depots (ICDs) are inland multi-modal terminals where goods in intermodal loading units can be transferred directly to seaports (Roso et al., 2009). Based on the relative distance from seaports, ICDs are classified into near ICDs (under 150 km), mid-range ICDs (from 150 to 500 km), and far ICDs (over 500 km) to suit multi-modal transportation. In the study by (Rodrigue and Notteboom, 2012), ICDs are divided into three types: satellite ports, ports serving as multi-modal transport hubs, and ports as transshipment centers. According to the approach, ICDs with the role of a logistics center can be classified into three main types: (i) logistics nodes, whose primary function is warehousing and storing goods; (ii) logistics centers with a prominent transport function; (iii) logistics centers focusing on value-added services.

ICDs have functions including distribution, consolidation, warehousing, customs services, and equipment maintenance. Van den Berg and De Langen (2011) have classified the functions of ICDs into basic functions for multimodal transport (transshipment of containers to different transport modes) and also providing a range of logistics services related to customer requirements; extended functions, considered to facilitate port flow and container consolidation, transporting to the port by rail or river.

Research in Malaysia has focused on summarizing the experiences at Padang, Besar, Ipoh, Nilai, Segamat, and Tebedu ports to highlight their significant contributions to the region's economic development (Zainuddin et al., 2019). ICDs

have also been shown to play an important role in job creation and supporting trade and import-export activities, reducing logistics costs by improving service quality. The study undetaken by Rodrigue and Notteboom (2012) analyzed the role and connectivity of ICDs to the economy of North America in comparison to European countries. This study indicated that one of the factors contributing to the development of the ICD system is rail connectivity, which enhances efficiency and service quality. Recent research focused on the role and contribution of the ICD system to the development of the logistics system and the economy of Nigeria (Akinade, 2020). Roso et al. (2009) identified the benefits of ICDs from the perspectives of stakeholders such as seaports, rail and road operators, shipping lines, shippers, local authorities, and society as a whole. In another study, Nguyen and Notteboom (2018) identified the common characteristics of ICDs through an analysis of 107 ICDs worldwide. The research results showed how ICDs are influenced by (1) the location of the port in relation to the sea and inland, the functions of the ICD; (2) the technical specifications of the seaport to which the ICD is connected, such as port traffic, connectivity, utilization, etc.; and (3) the transport distance linking the ICD and the seaport. From the perspective of factors affecting the development of ICDs, the study by Roso (2008) indicated that the most common factors hindering the implementation of ICDs are infrastructure, land use, environment, and legal regulations.

Studies on Inland Container Depots (ICDs) often focus on three main topics: cost reduction, container management at ports, and the green benefits of ICDs (**Table 1**). However, one extremely important topic that has not received corresponding attention is the factors affecting the quality of ICDs. It must be emphasized that if the quality of ICDs is not good enough, shippers and shipping lines may refuse to use them, leading to the failure to achieve the benefits of ICDs. The service quality issue is critical for the context of ICDs in developing countries where the logistics-related services at ICDs is rather limited due to the poor technical and infrastructure capacity (Bui and Nguyen, 2022; Cao et al., 2023). In addition, given the financial budgets, the understading of the important factors of service quality play a role in assisting both companies and (local) government to adopt appropriate and effective campagins and policies to develop ICDs sustainably. As such, studies of service quality for ICDs in emerging countries is needed.

Table 1. Selected studies of ICDs.

Studies	Topics		
	Cost reduction	**Container management**	**Green benefits**
(Roso, 2008)		√	
(Rodrigue and Notteboom, 2012)	√		√
(Roso et al., 2009)	√	√	
(Roso and Lumsden, 2010)	√	√	
(Cullinane et al., 2012)	√	√	
(Jeevan et al., 2019)	√	√	
(Nguyen et al., 2021)	√	√	√

This study aims to investigate the factors contributing to the service quality of ICD (i.e., the extent to which ICD users consider factors as significant or satisfactory) in a developing country. The data utilized covers some ICDs in the Red River Delta, Vietnam.

The rest of this paper is structured in four main parts. The subsequent section presents the establishment of the research model. Next, data collection and models are provided before results are shown and discussed in section 4. Finally, some conclusions are drawn together with research limitations.

2. Literature review and formulation of research framework

Logistics service quality at ICDs has been addressed at a limited level by some previous researchers (Mtshiselwa, 2014; Wiegmans et al., 2001). A typical study carried out by (Sayareh et al., 2016) with an evaluation of the service quality of Shahid Rajaee Container Terminal in Bandar Abbas port using SERVQUAL model. The findings suggested there are significant gaps between customers' expectations and perceptions of five dimensions of services quality. Tangibles was the most important predictor, followed by Reliability, Assurance, Responsiveness, and Empathy. In another research using factor analysis technique, Kolanović et al. (2008) reported the two critical dimensions of the port service quality included reliability and competence. A study of service quality in Nigerian ports highlighted the poor service quality and the main determinents are related to the provision of prompt services and the williness of staff to support customers (Ugboma et al., 2009).

Different from previous studies using extensions of SERVQUAL, we propose a model comprising four factors influencing the service quality of ICDs in **Figure 1**.

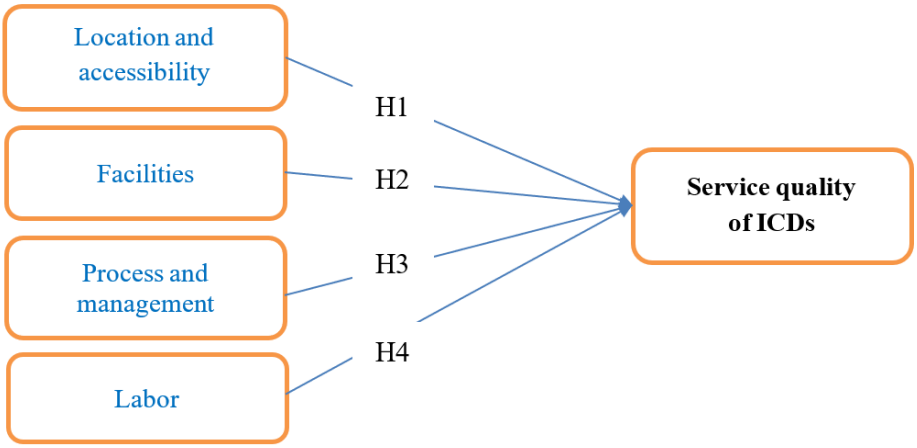

Figure 1. Research model proposed.

2.1. Location and accessibility

Ha et al. (2019) have demonstrated that the location of ICDs is one of the seven groups of factors influencing service quality at these ports, focusing on aspects such as centrality within the transportation network, connectivity to transport axes, and accessibility to large-scale multimodal transport vehicles

Cost reduction and time savings in transportation are primary reasons for stakeholders choosing to utilize the intermodal services of ICDs. Accessibility to

transport modes considers the ease of connecting to domestic transport from ICDs. For road transport, this includes proximity to highway ramps and daily traffic density (Laptaned, 2007).

ICDs offer a range of services including cargo reception, dispatch, packaging, consolidation of export goods, warehousing, container repairs, end-point transportation, customs clearance services, supply of handling equipment, and linking with downstream supply chain participants (Laptaned, 2007). The location of an ICD near industrial zones or export processing zones is a top criterion considered by shippers when selecting and evaluating ICDs. Proximity to logistics hubs or service provider facilities ensures operational success.

Hypothesis 1: Location and accessibility are associated with service quality in ICD.

2.2. Facilities

Moldabekova et al. (2020) reported the relationships and impacts of factors at inland container depots (ICDs) on logistics service quality, emphasizing the influence of physical infrastructure factors such as vehicles and cargo handling equipment, particularly highlighting the role of IT infrastructure in enhancing service quality. (Andersson and Roso, 2016) pointed out that for further development and significant contributions within the logistics system, ICDs need to develop and meet requirements related to modern infrastructure systems. Phan et al. (2020) found factors affecting service quality and customer satisfaction at container ports in Vietnam based on survey data from 108 businesses. Results indicated that container port service quality can be measured through factors including resource factors, output factors, process factors, management factors, image and reputation factors, and social responsibility factors.

Information technology can significantly impact logistics activities, facilitating collaboration and coordination among supply chain partners, and enabling automation of various logistics operations, allowing ICDs to focus more strategically on operational management issues. According to Closs (2003), information technology has directly influenced all aspects of logistics service provider's operations, including business outcomes, service quality, and operational costs. Similarly, Sauvage (2003) concluded that effective logistics service delivery to customers can enhance competitiveness, improve service quality, and increase productivity through the application of information technology.

Hypothesis 2: Facilities are associated with service quality in ICD.

2.3. Process and management

In a study of freight forwarding and maritime transport enterprises in Taiwan-China, Lai et al. (2004) demonstrated that the adoption of new ideas, new service delivery processes, new technologies, or new service management methods can provide superior value to customers, thereby enhancing the competitive capabilities of logistics service providers. Other studies have indicated that service quality indicators such as enhanced application of new technologies, equipment, and processes in service delivery can elevate service quality (Yang et al., 2009). Similarly, based on data from a survey of 108 enterprises, Phan et al. (2020) highlighted that the quality of container

port services can be measured through process factors and management factors. Pham and Yeo (2019) employed Partial Least Squares Structural Equation Modeling (PLS-SEM) to confirm aspects of port service quality and examine their relationships with customer satisfaction. The study revealed that management factors, image, and social responsibility significantly and positively impact service quality and customer satisfaction.

Hypothesis 3: Process and management are associated with service quality in ICD.

2.4. Labor

Woo et al. (2013) indicated that human resource factors (management and staff) such as knowledge, skills, adaptability, etc., are aspects that enhance service quality and operational effectiveness in ICDs. Similarly, Marlow and Paixão Casaca (2003) also demonstrated that these factors significantly impact service quality, competitiveness, and customer attraction in ports. Thai (2013, 2008) shown that aspects such as management and operational knowledge and skills, understanding customer needs and requirements, customer feedback, etc., among leaders and staff in ICDs, are conditions for improving logistics service quality at port service providers.

Hypothesis 4: Labor is associated with service quality in ICD.

3. Data and methods

3.1. Research area

Table 2. ICDs in the Red River Delta.

No	ICDs	Locations (Provinces)	Status			Transportation connection	Actual volume (TEUs) per month
			Capacity (TEU/year)	Area (ha)	Warehouse (m^2)		
1	Phuc Loc	Ninh Binh	100,000	10	50,000	Road, Inland Waterway	100–200
2	Mong Cai	Quang Ninh	200,000	15	110,000	Road, Inland Waterway	5000–8000
3	Ha Nam Tan Cang	Ha Nam	50,000	9.4	11,000	Road	300–350
4	Que Vo Tan Cang	Bac Ninh	105,000	10	30,000	Road, Inland Waterway	3000–4500
5	Hai Phong Tan Cang	Hai Phong	120,000	15	79,000	Road	1000–2000
6	ICD Hoang Thanh	Hai Phong	150,000	12.7	80,000	Road	
7	ICD Long Bien	Ha Noi	135,000	12.0	50,000	Road	1000–1500
8	ICD Tien Son	Bac Ninh	24,000	12.0	50,800	Road	1500–2500
9	ICD My Đinh	Ha Noi	20,000	5.2	22,000	Road	300–350
10	ICD Hai Duong	Hai Duong	91,200	17.5	45,600	Road	300–350
11	Đinh Vu-Quang Binh	Hai Phong	250,000	26		Road, Inland Waterway	300–350

The Red River Delta has 11 ICDs (**Table 2**), of which the officially announced ones include Phuc Loc (Ninh Binh), Ha Nam Tan Cang (Ha Nam), Long Bien (Hanoi), Que Vo Tan Cang (Hanoi). Bac Ninh), Dinh Vu Tan Cang, Hoang Thanh, Dinh Vu Quang Binh (Hai Phong), Mong Cai (Quang Ninh), My Dinh ICD (Hanoi) and

unannounced ones including: Hai Duong (Hai Duong) and Tien Son (Bac Ninh). With a relatively complete transportation infrastructure, many large seaports and inland waterway ports, provinces and cities in the Red River Delta region have enough potential and strengths to promote the development of logistics services, making important contributions to the country's supply chain, and socio-economic development. The ICDs in the Red River Delta are all located in favorable locations in key economic areas of the localities and the whole region, near economic centers, industrial parks as well as near seaports in the region. However, for far there has not been any evaluation of service quality of the ICDs in the Red River Delta based on their customers' views.

3.2. Data collection

The data for this study was collected from September to November 2023 via an online questionnaire posted on Google Forms. Specifically, the forms included three main parts. The first was a cover letter that shown the objective of this research. The second comprised several questions of companies' profile such as office location, facilities, services, and labor force. The last included various items (**Table 3**) that were adopted from the existing literature to measure latent variables included in the research model (**Figure 1**). These items were evaluated using a 5-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'.

The list of customers was achieved from 11 ICDs. The link was sent via emails and we also phone directly the customers (i.e., either shippers or general carriers who already used the services of ICDs) to request the participation of the survey. Finally, we collected 223 responses but we had to remove 21 because of the unreliable responses (i.e., providing the same answers to all questions in part 3). The final sample emcopassed 202 valid reponses.

Table 3. Items and constructs.

Code	Items/Constructs	Mean	Sd
LA	Location and Accessibility		
LA_1	The location of ICDs near industrial zones, production centers, and special economic zones.	3.8667	0.94122
LA_2	ICDs are located near transportation hubs.	2.8762	0.91667
LA_3	ICDs have information infrastructure connecting with relevant authorities.	3.8762	0.82852
LA_4	ICDs are simultaneously connected with multiple transportation modes (road, rail, waterway, air).	2.700	1.02282
LA_5	ICDs have information infrastructure connecting with logistics service providers.	3.866	0.92056
F	Facilities		
F1	ICDs have adequate area for functional zones (Cargo handling and storage area; Customs clearance area; Warehousing area; Recycling and packaging area...).	4.2952	0.89790
F2	There are various logistics services and equipment in ICDs.	3.5810	1.12473
F3	There are reliable and efficient information systems in ICDs.	3.6952	1.02960

Table 3. (*Continued*).

Code	Items/Constructs	Mean	Sd
F	Facilities		
F4	There are new and reliable vehicles in ICDs.	3.5810	1.12473
PM	Process and management		
PM_1	There is much application of IT in port management and operations in ICDs.	4.1905	1.04785
PM_2	ICDs have good port management team with good knowledge and capability, able to handle incidents.	2.9048	1.19714
PM_3	Port leadership is always dedicated to understanding practical needs and customer requirements.	3.2762	1.19852
PM_4	ICDs consistently collect customer feedback on services.	3.5762	1.01617
PM_5	ICDs continuously improve management and operational processes towards customer orientation.	3.0571	0.98867
L	Labor		
L_1	The staff in ICDs demonstrates a professional attitude and demeanor in meeting customer requirements.	3.7524	0.94849
L_2	ICDs' staff possess knowledge and skills, promptly addressing customer inquiries and requests.	3.8190	0.95857
L_3	Employees in ICDs consistently understand and grasp customer needs well.	3.5429	0.92016
L_4	Employees in ICDs have a strong ability to apply IT in customer service.	3.5048	1.00119
S	Service quality		
S_1	The service in ICDs is good enough	3.4283	0.96728
S_2	We impress with the service provided by ICDs	3.1448	1.02853

3.3. Methods

Statistical analyses were undertaken using STATA 15.0. First, descriptive statistics were run to show the level of aspects of service quality of ICDs. Subsequently, attitudinal statements were analyzed using exploratory factor analysis (EFA) based on principal component analysis (eigenvalue >1, Oblimin rotation approach with Kaiser normalization) to seek latent constructs. Eventually, linear regression was applied to recognize the factors influencing the service quality of ICDs. As the algorithms of EFA and linear regression are common in factor analysis and presented heavily in previous studies (Nguyen et al., 2024; Nguyen and Pojani, 2021; Tran et al., 2022), we did not present them in details.

4. Results and discussion

4.1. Descriptive results

4.1.1. Location and accessibility

With the primary function of Inland Container Depots (ICDs) being extensions of seaports, they contribute to alleviating congestion at seaports and urban traffic, reducing transportation costs, and port storage times. The factors of location and

connectivity in service provision play a decisive role in fulfilling these functions and the role of ICDs within the national logistics system.

Location of ICDs near industrial parks, production centers, and special economic zones: According to survey results, this factor for ICDs in the Red River Delta region is at a fairly good level, with an average score of 3.8/5 points. This result is consistent with the location of 11 ICDs in the study area. According to the planning and current location of ICDs, most businesses, when investing in construction, identify their target market areas as being close to industrial parks and economic zones with significant import-export activities.

Location of ICDs near transportation hubs: According to survey results, this factor for ICDs in the Red River Delta region is at a rather low level, with an average score of 2.8/5 points. This indicates that the accessibility of ICDs in the region to road, rail, inland waterways, and air transportation hubs is limited. The current situation of ICD locations shows that most ICDs only access major transportation hubs by road, thus greatly limiting their ability to meet and improve the quality of services provided to customers.

ICDs have information infrastructure connected to functional agencies: According to survey results, this factor for ICDs in the Red River Delta region is at a fairly good level, with an average score of 3.8/5 points. Some of the important services provided at ICDs are customs declaration services and other related services. At some ICDs, the Customs Sub-departments of provinces and cities have established and directly connected data systems on import and export goods. Therefore, at ICDs, this is one of the important factors greatly affecting the quality of services at the port. Under the current conditions of widespread IT application in logistics services, ICDs have continuously invested in and improved this factor to enhance their logistics service delivery capacity to customers, thereby improving the competitiveness of ICDs.

ICDs have simultaneous connections to various transportation modes (road, rail, waterway, air): According to survey results, this factor for ICDs in the Red River Delta region is at a rather low level, with an average score of 2.7/5 points. Out of all 11 ICDs in the Red River Delta region, only 03 ICDs have simultaneous connections to both road and river transport. However, due to limitations in vessel load capacity, navigability, hydrological factors, etc., in the river basin of the region, the service provision capacity of these ports is greatly restricted. Therefore, the connection of ICDs in the Red River Delta region with other transportation infrastructure, besides roads, is very limited.

ICDs have information infrastructure connected to logistics service providers: According to survey results, this factor for ICDs in the Red River Delta region is at a fairly good level, with an average score of 3.8/5 points. The level of IT use at ICDs is synchronized with all customers, which causes difficulties in providing integrated services. In reality, the IT systems at ICDs still do not meet the integration requirements of the logistics service industry. Accordingly, most customers cannot directly access all information related to orders, inventory status, etc., at ICDs.

4.1.2. Facilities

Sufficient area for functional zones: According to survey results, this factor for ICDs in the Red River Delta region is at a fairly high level, with an average score of

4.2952/5 points. ICDs in the Red River Delta region still have room for expansion in terms of overall area and functional zones. Therefore, ICDs need to focus resources on organizing and maximizing the use of available space to improve the quality of services provided.

Vehicles and equipment for logistics services at the port: According to survey results, this factor for ICDs in the Red River Delta region is at a fairly good level, with an average score of 3.5/5 points. To provide logistics services to customers, ICDs have continuously invested in and upgraded equipment such as 45T gantry cranes, forklifts for handling goods in warehouses and stuffing/unstuffing containers, conveyor belt systems for loading and unloading goods in and out of regular warehouses, as well as office equipment. This allows for improved quality of logistics services at ICDs.

Reliable and efficient information systems: According to survey results, this factor for ICDs in the Red River Delta region is at a fairly good level, with an average score of 3.6/5 points. The capacity to apply IT in service provision plays an important role for logistics businesses in general, and ICDs in particular, in attracting customers. Therefore, ICDs in the Red River Delta region have continuously invested in and improved their information system capabilities.

There are new and reliable vehicles in ICDs: According to survey results, this factor for ICDs in the Red River Delta region is at an average level, with a mean score of 3.5/5 points. Given the function of ICDs in the logistics system, vehicles are one of the important factors in meeting customer needs to the fullest extent. However, due to limited resources and operational networks, ICDs have not yet developed domestic and international transportation networks. Currently, ICDs in the Red River Delta region are mainly focusing on investing in container tractors, semi-trailers, trucks, etc., as part of their basic services, rather than providing a full range of transportation services like transportation companies do.

4.1.3. Process and management

Application of ICT in port management and operation activities: According to survey results, this factor for ICDs in the Red River Delta region is at a high level, with an average score of 4.1/5 points. In fact, all 11 ICDs in the Red River Delta region have been applying ICT-digital transformation in their operations at various levels.

The management team at the port has good knowledge and capabilities, with the ability to handle incidents: According to survey results, this factor for ICDs in the Red River Delta region is at a rather low level, with an average score of 2.9/5 points. Due to the rapid development of the logistics service market, there is a shortage in both quantity and quality of human resources. Especially, under the conditions of ICT application in all logistics service provision activities at ICDs, management human resources are required to continuously learn and supplement knowledge accordingly.

The leadership at the port is always dedicated to grasping the actual needs as well as the requirements of customers: According to survey results, the average score for this criterion is 3.2762/5 points. The ability to provide services at ICDs is still mainly basic services such as warehousing, yard services, container lifting services, etc., and there are not many value-added services or customized package services according to individual customer requirements. This is also a limitation in providing logistics services at ICDs.

The port always collects customer feedback on services: According to survey results, the average score for this criterion is 3.5762/5 points. To continuously improve service quality, ICDs have regularly conducted surveys to collect customer information, thereby having a basis for continuous improvement of activities to maximize customer satisfaction.

The port continuously improves management and operation processes towards customer orientation: Currently, most ICDs in the Red River Delta region cannot provide full package logistics services, but must rely on some outsourced services such as domestic vehicles, etc. The operational processes for providing logistics services are mostly basic processes and applied generally to all customers and have not yet been able to move towards providing specific service processes that meet the specific requirements of customer groups. According to survey results, the average score for this criterion is 3.0571/5 points.

4.1.4. Labor

Staff members have a professional attitude and manner that meets customer requirements: According to the survey results, the average score for this criterion is 3.752/5 points. The majority of human resources at ICDs are residents who have not been formally trained and lack extensive experience and skills in performing logistics activities. However, ICDs always show concern and create conditions for logistics staff to participate in training, supplement knowledge, and update information on customs declaration procedures and documentation.

The staff at the port always quickly addresses customer inquiries and requests: According to survey results, the average score for this criterion is 3.81/5 points. Among the criteria for logistics service quality, the ability to quickly respond to customer wishes and demands has been a focus for ICDs.

Staff at the port always understand and grasp customer needs well: According to survey results, the average score for this criterion is 3.54/5 points. Currently, ICDs have continuously established, developed, and consolidated sustainable relationships to approach business partners and customers, thereby integrating logistics service provision activities more deeply into the customer's service chain.

Staff's ability to effectively apply ICT in customer service: According to survey results, the average score for this criterion is 3.50/5 points. With the explosion of ICT in logistics service provision, customer service activities at ICDs have been highly automated and specialized.

4.1.5. Service quality

Both items measuring service quality were slightly higher than the average level of 3. As such, customers thought that the service of ICDs was at an acceptable level but far from the high one (e.g., 4 point).

4.2. Exploratory factor analysis results

The Kaiser–Meyer–Olkin (KMO) test, which is a statistical measure to estimate how suited data is for factor analysis, was applied. It is a measure of the proportion of variance among variables that might be common variance. The higher value of KMO refers that the data is more suited to factor analysis. For our case, the Kaiser-Meyer-Olkin measure (KMO = 0.8328) confirmed the sampling adequacy.

The Bartlett's test of sphericity checks the null hypothesis that the variables are orthogonal (i.e., not correlated). If the *p*-value from Bartlett's Test of Sphericity is lower than 0.05, the null hopthesis is rejected (i.e., existing correlations between variables). For our case, the results of Bartlett's test of sphericity ($p < 0.000$) suggested that correlations among attitudinal items were sufficient large to utilize EFA. The derived factors accounted for 65% of the variance of data. As such, the utilization of EFA was appropriate. The EFA's results (**Table 4**) suggested the four six latent constructs with all of corresponding items' factor loadings being over 0.7, as follows: (1) Location and accessibility, (2) Facilities, (3) Process and management, (4) Labor. Generally, the results of EFA were in line with our proposed research model (**Figure 1**).

We also applied the EFA procedure to the two items of measuring service quality of ICDs. The results confirmed that one factor found and named service quality of ICDs). The value of KMO, explained data variance were 0.7383 and 71%, respectively. The Bartlett's test of sphericity was significant.

Table 4. Extracted factors from EFA.

Code	Extracted Constructs			
	Location and Accessibility	**Facilities**	**Process and management**	**Labor**
	Factor loadings			
LA_1	0.7362			
LA_2	0.7625			
LA_3	0.8213			
LA_4	0.8326			
LA_5	0.7928			
F1		0.8211		
F2		0.8438		
F3		0.8537		
F4		0.8629		
PM_1			0.7262	
PM_2			0.8762	
PM_3			0.8326	
PM_4			0.8129	
PM_5			0.8624	
L_1				0.8132
L_2				0.7921
L_3				0.7529
L_4				0.7213

4.3. Influential factors of service quality of ICDs

Table 5 presents the result of analyzing the influential factors of service quality of ICDs. All of the independent (latent) variables had VIF values being less than 2, thus multicollinearity issue was relieved. The adjust R^2 value of 55.2% was over than 0.5, thus the prediction capacity of the estimate model was adequate.

Table 5. Results of influential factors.

Model		Standardized Coefficients		*t*	Sig.	VIF
		β	**Std. Error**			
1	(Constant)	5.364×10^{-16}	0.066	0.000	1.000	
	Location and accessibility	0.324	0.085	4.011	0.000	1.372
	Facilities	0.281	0.076	3.866	0.000	1.482
	Process and management	0.257	0.068	3.490	0.001	1.278
	Labor	0.214	0.079	2.538	0.013	1.317

In line with our expectations and the report of previous studies (Lai, 2004; Laptaned, 2007; Thai, 2013), all four latent constructs were positively associated with the service quality of ICDs. As such, the four proposed hypotheses (H1, H2, H3, H4) were confirmed.

Among constructs, location and accessibility was the most important factor for enterprises. It can be understood that location and accessibility were directly involved in transportation costs, which are one of the main contributors to the price—one of the most important predictors of service quality at ports (Thai, 2013; Ugboma et al., 2009). Location with poor accessibility may lead to poor reliability, particularly for transportation (Phan et al., 2020). Additionally, mistakes in location selection are difficult to fix, and the enhancement of accessibility requires substantial investment and time (because of the impact on infrastructure). While location can be considered an external factor, the rest were internal factors for ICDs. Based on the magnitude of the effects, the list included facilities, process and management, and labor. The facilities are undeniably decisive in the safety and reliability of activities in ICDs (Laptaned, 2007). From the service perspective, facilities are the obvious and strongest tangibles that impress customers (Kolanović et al., 2008). Meanwhile, management is hardly considered an important factor of service quality previously because customers witness it partly. However, the management process has become more visible through the online system, which customers can access to catch updated information. Labor has a minor influence. This finding differs from the report of Ugboma et al. (2009), who emphasized that the direct support of staff is one the most influential variables of service quality in ports. However, our result may stem from the fact that the labor market in this field is relatively affluent and well-trained, as well as the application of information communication technologies.

5. Conclusions

The contribution of ICDs to regions' economic and social growth is undeniable. To achieve the sustainable development of ICDs, evaluating and improving their service quality is critical. Desired by this idea, we have conducted a quantitative analysis of the service quality of ICDs located in the Red River Delta region, Vietnam. Generally, the service quality of ICDs was evaluated at an acceptable level but far from the high one. The results suggested that the four influential service quality factors included location and accessibility, facilities, process and management, and labor.

Based on the findings of factors and descriptive statistics, some managerial implications were proposed as follows. Location choice is the most crucial focus when

creating logistics and transportation plans. Various data should be collected to build algorithms to select the locations of ICDs with the highest multimodal accessibility (Ambrosino and Sciomachen, 2014; Božičević et al., 2021; Tadić et al., 2020). The accessibility should be improved continuously through the construction of expressways, enabling the reduction of travel time. The facilities and management process should be fostered based on the application of the new technologies, probably resulting in a higher requirement for labor. As such, ICDs may need to keep in touch closely with universities or colleges in terms of educating and training students. Bodies of (local) government may need to propose policies and campaigns to improve the working and living conditions for the laborers in ICDs since most of them are locals. The aspects of constructs (i.e., items) with a score of under 3 (see Section 4.1) should be considered to be improved; however, we believe that aspects may differ across case by case. Thus, it is not necessary to propose detailed solutions based on them.

This study has provided an empirical evidence of analyzing the factors associated with the service quality of ICDs in a developing country. The findings of effects of the four factors (i.e., location and accessibility, facilities, process and management, and labor) has enriched the literature. Unfortunately, this study is also subject to several limitations. Firstly, our work relied upon self-reported data from companies. On the one hand, this is a subjective data collection, possibly leading to bias in the findings. On the other hand, this data collection is widely accepted in previous analyses of service quality (Nguyen, 2021; Nguyen and Pojani, 2024). Secondly, our study was carried out based on data from a region of Vietnam. As such, the findings of this research may not apply entirely to other areas with different transportation and economic conditions. Thirdly, our paper only considered four constructs while ignoring other possible predictors, such as policies. Therefore, more research is needed to validate and expand our results. A comparison of service quality in different areas may provide interesting findings.

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