A Study on Supply Chain Management and Characteristics of Container Port Operation Efficiency in Vietnam by Emerging Measure Tools

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Abstract

Seaport services are an important and decisive focal point in improving the logistics process's efficiency. Several prerequisites such as productivity and customer satisfaction are considered to be mandatory measures of port performance. Therefore, the determination of the characteristics and the evaluation of the effects of those important factors on the efficient operation of the port has always attracted much attention from scholars. This work aims to identify and evaluate the factors of port characteristics affecting container port operation efficiency. As a result, the port operation is more efficient. The competitiveness is enhanced in the context of fierce competition in seaport business in general and container ports and container terminals in particular. With qualitative methods combined with quantitative, using a 5-point width scale, analysis according to the linear structure model (SEM) with 530 samples. The research results show that 6 factors belong to the characteristics of container ports: infrastructure, location, inland connectivity, dynamism, logistics services, attractiveness impact the performance of container port operation. As meaningful, the study can bring benefits to port and container terminal businesses to build the right policies and decisions in competitiveness enhancement and help policymakers and port planning have an overview when implementing the plan.

Keywords

Port Characteristics, Port Operation Efficiency, Supply Chain Management, Emerging Measure Tools.

Introduction

The theory of port operation efficiency does not develop in a straight line. Breakthroughs in international shipping by containers have increased the debate about port performance and the determinants of port performance. The obvious reason is the trend of containerization and competition among ports to win the right to become the hub of transport connections in international trade. Jiang et al. (2013) studied the factors that greatly affect container port operation efficiency. Besides, Willingale (1984) have shown that a container port operates effectively when conditions such as favourable geographic location, frequency of calls at the port, and port charges are appropriate. In the following years, Chang et al. (2008) added port facilities. As a result, they believe that a container port with good facilities besides a good location and a good port may be a condition for customers to choose in a competitive environment. Regarding container port operation efficiency and maritime costs in international container transport, Wilmsmeier et al. (2006) studied and evaluated that port connectivity and dynamic communication with customers could reduce transport costs for carriers. Consequently, dominating the choice of container ports by ship owners and cargo owners could increase the competitiveness and efficiency of port operations (A.A.R. Alkhafaji et al., 2021).

During the modern port development stage, Felício et al. (2015) argued that container port elements included in the front and rear lines were port characteristics that would affect port performance. These include locations, dynamics, connectivity, organization of port logistics services, port infrastructure. These factors may have determined the efficiency of container port operation through port customer satisfaction other than shipowners and cargo owners. Meanwhile, the forwarding enterprises and the volume of ships entering and leaving the port and productivity, the port performance from which the ports have been able to improve their competitiveness. However, these theories do not explain that in countries with large seaport systems located on inland tributaries and inland areas like Vietnam, which characteristics can determine container port operation efficiency. In other words, what is the most important feature and the most impact on the efficiency of port operations, namely container ports? In Vietnam, in the study, Dang et al. (2017) of solutions to develop the southern port to 2017, the risks, opportunities, strengths and weaknesses of the southern port cluster depending on locations, infrastructure and inland connectivity capacity was reviewed.

Meanwhile, Nguyen et al. (2016) studied strategic solutions for seaport development in Ho Chi Minh City. According to this study, infrastructure and connectivity, as well as logistics services, have affected affect port development. However, this study has not updated the new issues arising in the development plan for Vietnam's seaport of the Ministry of Transport until 2020 and the vision to 2030. Pham et al. (2016) researched complete solutions and container port operations for multimodal transport. Research results have shown that an efficient container terminal needs to improve loading and unloading technology, connectivity information technology, port logistics services, and a workforce.

Approaching from a practical perspective, Vietnam's economy has grown well in recent years, which has resulted in a corresponding increase in cargo demand. In the past 10 years, freight volume doubled to more than 293 million tons in 2018, equivalent to 13 million TEUs. In the structure of shipping, imports and exports account for about 60% and 40% of domestic cargo (T. X. Tran et al., 2021). This shows the role of the shipping industry is constantly increasing, especially for container shipping. Intending to serve international trade activities, it has been developing strongly in increasing international economic integration of Vietnam, and container shipping volume usually accounts for an overwhelming proportion of goods import and export activities (N. Hoang Phuong, et.al., 2019). Therefore, the investment in perfecting the container port system to improve the PCPO of this type has become an urgent requirement for the economy. Vietnam currently has 45 seaports, 251 berths, 87.5 km of wharves, 18 transhipment berths, and 33 ICDs, but the number of deep-water ports and container terminals is too small. Most container ports only meet the needs of small vessels while the demand for large container transport.

Moreover, shipping lines that want to reduce costs should bring large capacity container ships into operation. Those demands have caused Vietnamese seaports to start to show many shortcomings, such as lack of roads, weak port infrastructure, frequent congestion roads, and ports in cramped and inconvenient cities for traffic. From the above facts, it can be seen that the seaport system in general and container port in particular in Vietnam so far has not met the corresponding development requirements.

Both objects and goals, the efficiency of using and operating our container port system are still low, not commensurate with the potential and advantages. At present, most container ports still use outdated management and exploitation technologies and limited handling capacity (only reaching 45% - 50% of the world's advanced level). Meanwhile, some container ports, due to the lack of visibility in the master plan, cope with local growth, make it difficult to connect to establish a synchronized and tight national transportation network. This results in a large number of ports and small cargoes and weakens the capacity to clear cargoes at ports that are large urban areas, which are under pressure of rapidly increasing population and transport infrastructure. Degradation. The ports have not developed in line with the Government's orientation plan. Many ports are still waiting for goods, waiting for ships, lack of connectivity, and ineffective exploitation.

The research in the previous years on the PCPO has mainly focused on studying the specific impact of each port's organization on the efficiency of port operation. Without research on measuring the port's specific factors' overall impact on container port operation efficiency (E.N. Al-Khanak et al., 2021). Therefore, based on theory and practice, the author proposes to study the effect of port characteristics on container port operation efficiency in Vietnam. With the desire to clarify which factors of the port affect the PCPO in Vietnam (V.V. Pham and A.T. Hoang, 2020). This study's main objectives include: Studying and discovering factors expressing characteristics of container ports; To measure the combined impact of port performance characteristics on the PCPO in Vietnam; Proposing administrative implications to improve the PCPO. This study uses a flexible method of combining basic scientific research methods, which are qualitative research methods and quantitative research methods. Subjects of the survey are researchers, experts in container port operation, the managers of the ports, the ICD with container cargo. Besides, the research also uses the object of observation that is experts, researchers in seaport exploitation. The scope of this study is the system of ports and harbors of ICDs that handle containers. This research was conducted for the Vietnam market. This study was conducted from 2016 to 2020. The container ports are part of the service system for ships on feeder routes.

Literature and Theoretical Fundament

The Scale of Infrastructure Facilities

Infrastructure characteristics or port facilities are inherited from the research results of (R. Tolley and B.J. Turton, 2014). Tongzon (2009) measured container port infrastructure by the number of container terminals, crane quality, tractors, towage, container yards, information systems, intermodal transport connectivity systems, and port management systems. Chang (2008) mentioned port availability, special requirements, staff communication, service reliability, world port reputation, information technology capabilities, customs procedures. Also, from the view of Aronietis et al. (2010) concluded that port facilities are the number of berths and the number of deep-water wharves.

A container port's physical infrastructure is a material and ownership element of the port formed from the construction, investment, and development process. Through the synthesis of this scale theory, many researchers developed. Port infrastructure refers to many ports handling equipment and the number of modern port equipment (Č. Dundović and S. Hess, 2005). Or the number of cranes on the wharf length, the average number of deep-water piers and piers, the deep-water harbor is the harbor with a suitable water level in front of the deep berth measured in meters (M.R. Van Der Horst and P.W. de Langen, 2015). This scale is also measured by many researchers using a port incident repair system, standard facility conditions, high container loading, and unloading capacity. According to Van and Langen (2008), port infrastructure is a characteristic that affects the efficiency of European ports' operation. Investing in infrastructure to reduce costs and improve service quality is a legitimate and important demand affecting port performance (P.H. Tseng and C.H. Liao, 2015). Therefore, the infrastructure scale in the proposed 7 statements is shown in Table 1.

Table 1 The scale concept of port infrastructure facilities

Symbol	The scale
Inf1	The infrastructure that is referring to the modern port facilities;
Inf2	Port facilities include a standardized incident rescue system at the port;
Inf3	High container loading and unloading conditions of port infrastructure;
Inf4	Infrastructure conditions are of a high standard for port infrastructure;
Inf5	The infrastructure that is referring to a large number of births;
Inf6	That infrastructure is referring to the number of deep-water wharves;
Inf7	That infrastructure includes a large number of loading and unloading equipment.

Container Port Location

The qualitative research process helped the author inherit study on the important role of port location characteristics as it contributes to port performance. This is also confirmed by (Vitor Dias da Silva, 2006), when the distance between container port location and production centre, domestic market and reasonable economic development areas is always an advantage. The same viewpoint (X. P. Nguyen and V. T. Pham, 2019) also suggest that this is the most important factor in the conventional view of port operation. Port location can be considered the distance from the port to the customer's warehouse or the ports. The port's position is measured by the convenience of transportation, near industrial parks, export processing zones, commercial centres, near major ports in the region. In addition to the new measurement variable, the channel distance is short, the port is close to other associated ports including depots.

A container port's location is where the port is chosen for investment, construction, and development. Usually, when customers choose a port, the port's location has a great impact on the customer's cost. Port locations can be considered as the distance from the port to the customer's warehouse, the ports together, or near major maritime routes or the distance from ports to commercial centres, near export processing zones, and Eurasian continental shelves, or transhipment ports (K. Kim, et. al., 2018). Therefore, the port location-scale in the study of the proposed 9 statements is shown in Table 2.

Table 2 The scale concept of the port location

Symbol	The scale
Loc1	Port location can be near major transhipment ports in the world (Singapore Port, Hong Kong Port);
Loc2	I think the location of the port is such that the distance is short for the ships to enter the port;
Loc3	The location of the port can be considered as the distance from the port to industrial parks and export processing zones;
Loc4	The ports are located near the Eurasian continental shelves;
Loc5	The associative route to the port is suitable for the transport of large quantities (e.g. railroads, highways, barges ...);
Loc6	Ports near other associated ports include Depots;
Loc7	The port location has a favourable geographical position;
Loc8	The location of the port can be considered as the distance from the port to the main shipping routes;
Loc9	The location of the port is the distance to the commercial centre.

Domestic Connectivity

This is the ability to connect the rear of the port; the shipping lines usually load and unload at the ports located in the city where their customers are based, expanding the internal transport system connection. It is crucial for shipping lines to expand their services by choosing shipping ports with inland transport access systems (D. A. King, et.al., 2014). The inland transportation system is an important factor in choosing shipping lines for shipping lines and shippers. The port's inland connectivity is expressed by its ability to connect the port to a highland logistics network or some roads to the port (J.L. Tongzon and S.-Y. Lee, 2016). For some European ports studies, the inland port capacity also shows that the port can connect the railway. However, Vietnam's actual situation currently does not have a container port connecting the railway, so the author did not mention it. Characteristics of domestic connectivity in the study of (V. Caldeirinha and J. A. Felício, 2011) related to the ability to connect railway, roads, logistics network integration, logistics network connection with inland ports. Thereby ensuring the transport of goods to the place on time with the lowest cost, satisfying customer requirements. If a container port can synchronize connectivity between modes of transport, it will bring confidence to shippers. Results of interviewing experts to add 3 observed variables for this concept scale: the diversity of river routes to ports, the logistics capacity of large regional logistics companies, and the ability to connect river and road networks into large container yards. Therefore, the scale of domestic connectivity in the literature review is proposed 5 statements are shown in Table 3.

Table 3 The conceptual scale of domestic connectivity

Symbol	The scale
Inl1	I think the port's domestic connectivity is that there should be many river routes to the port;
Inl2	There are many roads to the port to increase domestic connectivity;
Inl3	The connectivity of the port to the inland logistics network is high, increasing the ability to connect inland;
Inl4	I realize that the shipping capacity of logistics companies in large areas will increase the inland connection of the port;
Inl5	In my opinion, the port's inland connectivity is the ability to connect river and road networks to container yards.

The Dynamics of Port

The port's dynamics or flexibility is expressed in its ability to quickly adapt to customer requirements, to be ready to respond when needed; today, the success of container ports depends on its strategic direction, according to customers (M.R. Van Der Horst and P.W. De Langen, 2008). According to (P.H. Tseng and C.H. Liao, 2015), the port's dynamics are also reflected in the dynamic port docks, the dynamic port services, whether the port management is active in communication and handling situations.

Port dynamics show a dynamic exchange of information with customers and port management. The dynamics of a port also reflect the popularity of that port yard. Besides, when the author interviewed experts (D. Dragan, et. al., 2020) who used port services, they said they chose the port because of the dynamic port service quality. Therefore, the dynamic scale in the study of the proposed document is shown in Table 4.

Table 4 The scale concept of port dynamics

Symbol	The scale
Dyn1	A dynamic container port is a container terminal of a dynamic port in operation
Dyn2	In my opinion, the dynamic port service will increase port dynamics
Dyn3	An active port means that the port must be active in exchanging information with customers
Dyn4	An active port is a dynamic port in the management
Dyn5	A dynamic port means that all activities of the port must be active

Attractivity Characteristics

Attractivity characteristics, according to Felício et al. 2013, maritime service is measured by the frequency of vessels calling at the port when the number of transhipment ships. Frequent intercontinental transport vessels to the port mean that the volume of cargo through the port is large, so the more ports a ship calls, the more it will attract customers, increasing port productivity. According to Du et al. (2017), an effective port to attract shipping lines needs appropriate channel depth. Fu et al. (2016) argue that the number of the 10th largest shipping lines in the world will motivate the port to attract more customers, thereby bringing efficiency. In the same opinion, the number of transhipment vessels helps a port increase its attractiveness. Besides, with the operation of shipping lines, the owners always consider choosing the port to put the vessel based on the harbour's depth or the depth of the water in front of the harbour or channel depth access. Therefore, the scale of attractiveness in the study of the proposed document of 6 statements is shown in Table 5.

Table 5 The scale concept of port attractiveness

Symbol	The scale
CA1	Appropriate wharf height will increase the likelihood of attracting the vessel;
CA2	The appropriate depth of the water in front of the harbour will increase the ability to attract ships;
CA3	A port will increase the attractiveness of ships, should have appropriate channel depth;
CA4	There are many world-class ships of the world's top 10, which means their ability to attract high ports;
CA5	The number of shipping lines transiting to port (Feeder's vessel) will attract branch customers;
CA6	An attractive transport hub is the number of transcontinental shipping lines that travel to such hubs (Mother ships).

Organize Port Logistics Operations and Services

The organization and operation of logistics services are measured by management systems, information systems, port charges, port structure organization, towage pilot services, transhipment services, convenient harbour structure for use reduces costs and time for customers (W.H. Dickhoff, et. al., 2017). The consequence is an increase in the port's productivity and efficiency, or an increase in the throughput of goods in the port, thereby affecting the efficiency of port operation. The port's operations aimed at customer service or activities such as design and port organization structure that help reduce costs for customers. Besides, good management of port systems and other services such as towage, transhipment, and port charges are good. When the author interviewed experts that customers were using port services, they said they chose the port because the port's customs clearance service was convenient. Therefore, the scale of organizing logistics service activities in the literature review is proposed 10 statements are shown in Table 6.

Table 6 The scale of the concept of port logistics operation and service organization

Symbol	**The scale**
L1	Building a good port management system to organize effective port logistics services;
L2	Organizing effective logistics services means building information systems quickly and promptly;
L3	Convenient harbour structure for use reduces costs and time for customers;
L4	Container terminal design is convenient for use, reducing costs and time for customers;
L5	Arranging suitable loading and unloading equipment;
L6	Port operation is organized in service of customers;
L7	Service of towing ships to ports is quickly organized to increase the efficiency of operation;
L8	Fast delivery service;
L9	In my opinion, convenient customs clearance service is a factor that affects the efficiency of exploitation;
L10	Good port charges are factors related to port logistics services;

Port Customer Satisfaction

According to Tongzon (2009), port performance is expressed by the speed of delivery, the port's reliability, the cost, and the fast turnaround time. According to (S.L. Chao and C.C. Chen, 2015), delivery time is a top concern to satisfy customers of the port. Also, defining customer satisfaction is their status when feeling about service quality compared to their expectation. Customer satisfaction can be divided into 3 levels: ideal (very good), expect (good), and fit (the last level that customers can accept). Depending on the distance between the services of the seaport that the customer receives and the customer's expected value, the level of customer satisfaction can range from very satisfied to very dissatisfied. Customer satisfaction with seaports is made up of 2 components: Functional and Relationship satisfaction.

Shippers are also more concerned with the indirect costs associated with delays, loss of market/market share, loss of customer confidence and opportunities missed due to inefficient service, compared to port charges. Willingale has pointed out that some users are willing to accept higher port costs in return for superior and more efficient services. Containers are a prerequisite for the development of global maritime logistics services. The competition between ports for domestic routes and main maritime routes has become increasingly fierce in recent years. The ports do not hesitate to expand to serve their customers better, receiving large ships, serving the requirements of quality, price, and bringing satisfaction to customers. According to Du et al. (2019), Port operation efficiency is measured by port customers' satisfaction, such as shipping lines, shippers, and forwarding agents. In a competitive environment, customer satisfaction is very important to the port. It is determined by factors such as the ability to organize the port's logistics, the port near the place of production and consumption, the ability to connect inland. The level of competition among the ports is increasingly changing, and instead of ports as competitors, now it is the links, alliances of ports and shipping lines that form a chain. Therefore, one of the factors determining the efficiency of port operation is customer satisfaction. According to (Vitor Dias da Silva, 2006), an effective port of operation is determined by productivity and efficiency and the satisfaction of port customers such as shipping lines, shippers, and forwarding agents. Therefore, the scale of port customer satisfaction in the study of the proposed document 3 statements (Sat1, Sat2, and Sat3) is shown in Table 7.

Table 7 The scale of port customer satisfaction concept

Symbol	The scale
Sat1	In my opinion, an effective port means that the shipper is very satisfied with the port service;
Sat2	In my opinion, an effective port means that the shipowner is very satisfied with the port service;
Sat3	In my opinion, an effective port means that the forwarding agent is very satisfied with the port service;

Port Productivity and Performance

Port performance results from servicing goods and vessels in specific numbers, such as throughput of port profits. However, in recent years, many authors have used the basic Data Envelopment Analysis (DEA) model to the condition that the production results are unchanged according to the scale and SFA (Stochastic Frontier Analysis) method to analyze the efficiency of container port operation. According to (Vitor Dias da Silva, 2006), the study on the growth of Spanish ports from different port groups based on port performance relationship using DEA method. Ryoo et al. Also assessed the performance of 26 Asian container ports using the DEA method. According to (S.M. Cheong, 2012), it was shown that the length of the pier, the number of loading and unloading equipment as input data to use DEF to analyze port performance, and the output is the amount of TEU (Twenty Equivalent Unit) through. Brooks argued that port performance and port competitiveness are measured by port performance, or that there are two concepts related to port performance: port performance and productivity. Therefore, the scale of productivity and port performance in the literature review is proposed 2. Statements called H4 are shown in Table 8.

Table 8 The scale concept of port performance and performance

Symbol	The scale
Cap1	In my opinion, effective port operation means large port productivity;
Cap2	In my opinion, efficient port operation means high port performance;

Port Operation

In most of the studies, the port's main exploitation efficiency was shown to be the capacity using ports, cranes, equipment, and port operations and is usually denoted by numbers like tons passed or container passed. Port operation efficiency is also assessed by port activities' efficiency, including the number of containers transshipped at a port besides a port considered effective. The frequency of calls at the port of loading should be high and be arranged so that the wharf space is low. Therefore, the scale of port operation activities in the study of the proposed document 3 statements are shown in Table 9.

Table 9 The scale of the operation concept of a port

Symbol	The scale
Ter1	In my opinion, an effective port means that there are many sources of goods entering and leaving the port;
Ter2	In my opinion, an effective port means that there is a large number of containers transshipped at the port;
Ter3	In my opinion, the effective exploitation port means that the frequency of ships calling at the port is much;

Materials and Methodology

Research Models and Hypotheses

The author proposes a research model based on Figure 1. The questionnaire is designed on a 5-point Likert scale. Survey subjects are the managers and operators of container yards and container ports.

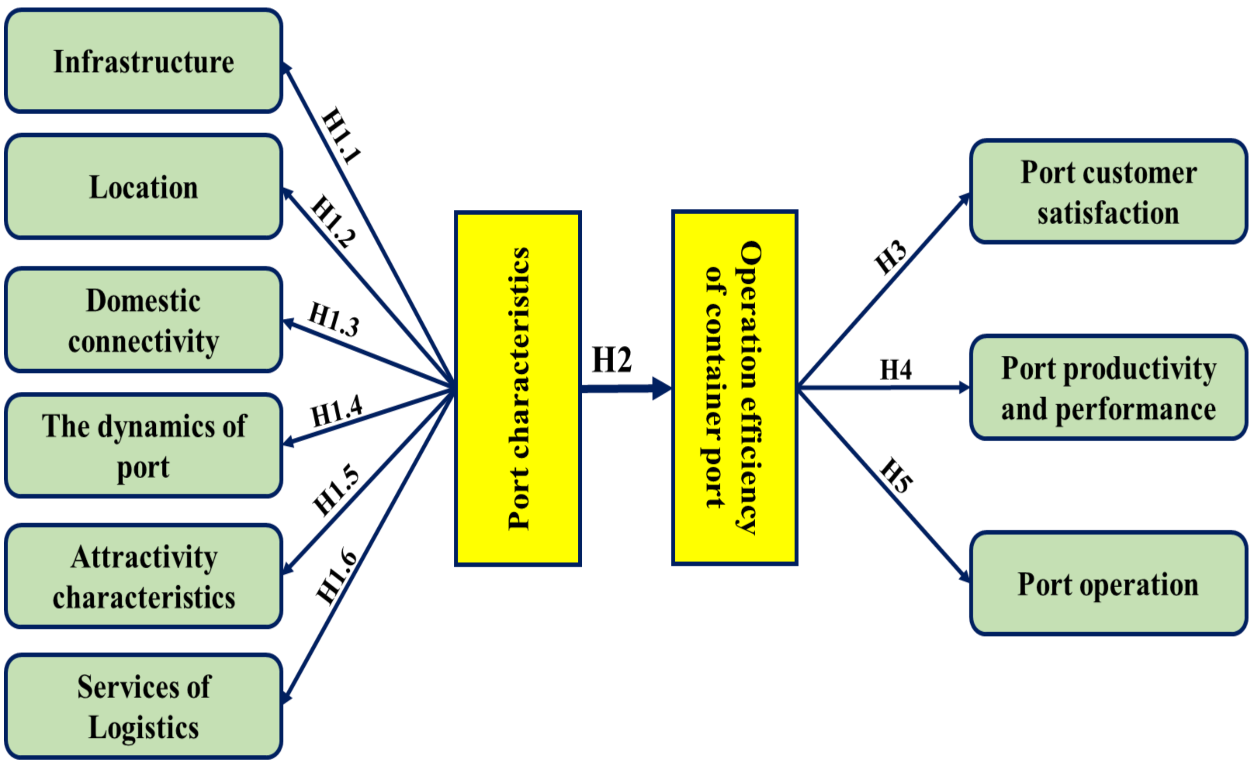

Figure 1 The model with the five-point scale

Research Process

The study is carried out in a 3-step process, as shown in Figure 2.

Step 1: Building observation set, using qualitative methods to determine observed sets. Based on the literature, I form a set of draft scales: port location-scale, port infrastructure, dynamics, inland connectivity capacity, ability to attract and organize Logistics services, and port operation efficiency. The author then discussed the group with two expert groups: senior managers of some container terminals, researchers teaching port operators from Universities, and Logistics Institute. On that basis, I am adding scales and conceptual components without scales, discovering additional relationships between concepts in the model, adding observation sets, and discovering new components in the scale to form a draft scale II.

Step 2: Preliminary quantitative research is used to evaluate the official scale preliminarily. In this step, the author adopts a questionnaire interview technique with a 5-point Likert scale to interview 195 port and container terminal managers at a minimum 5:1 ratio (A. Joshi, et. al., 2015). Preliminary quantitative research has mainly been conducted in the survey of container terminal and port management in Ho Chi Minh City, Binh Duong, Vung Tau and Dong Nai. Using SPSS-25 software to handle data cleaning, then checked Cronbach-Alpha reliability with requirements> 0.8, then test the measurement by EFA analysis with PCA-Varimax provided that eliminating variables with EFA weight <0.5 (M. Bellmann, 2016). The total correlation coefficient (Item - total correlation) <0.3 will be removed for observed variables. The remaining variables will be included in the questionnaire for official quantitative research.

Step 3: Official evaluation confirms the reliability and scale value; this is the official quantitative step. Based on the official scale, the author designed the questionnaire with a 5-point Likert scale. Therefore, to achieve good results, the author used the sample size n> 500 because the official observed 50 variables. The data is processed on SPSS-25 software. The scales continue to be tested by Cronbach Alpha coefficient with requirement> 0.6, Barlett test (used to consider correlation matrix) with p <5% means that the variables are related to each other, KMO test to compare the magnitude of the correlation coefficient of variables with KMO must accept> 0.5. Then continue to run EFA with Promax rotation. The author then used AMOS-25 software to analyze the CFA affirmation factor. Besides, the author continued to test with the linear structure model SEM. Finally, the author used the Bootstrap method to re-estimate the model parameters and qualitatively interviewed the results.

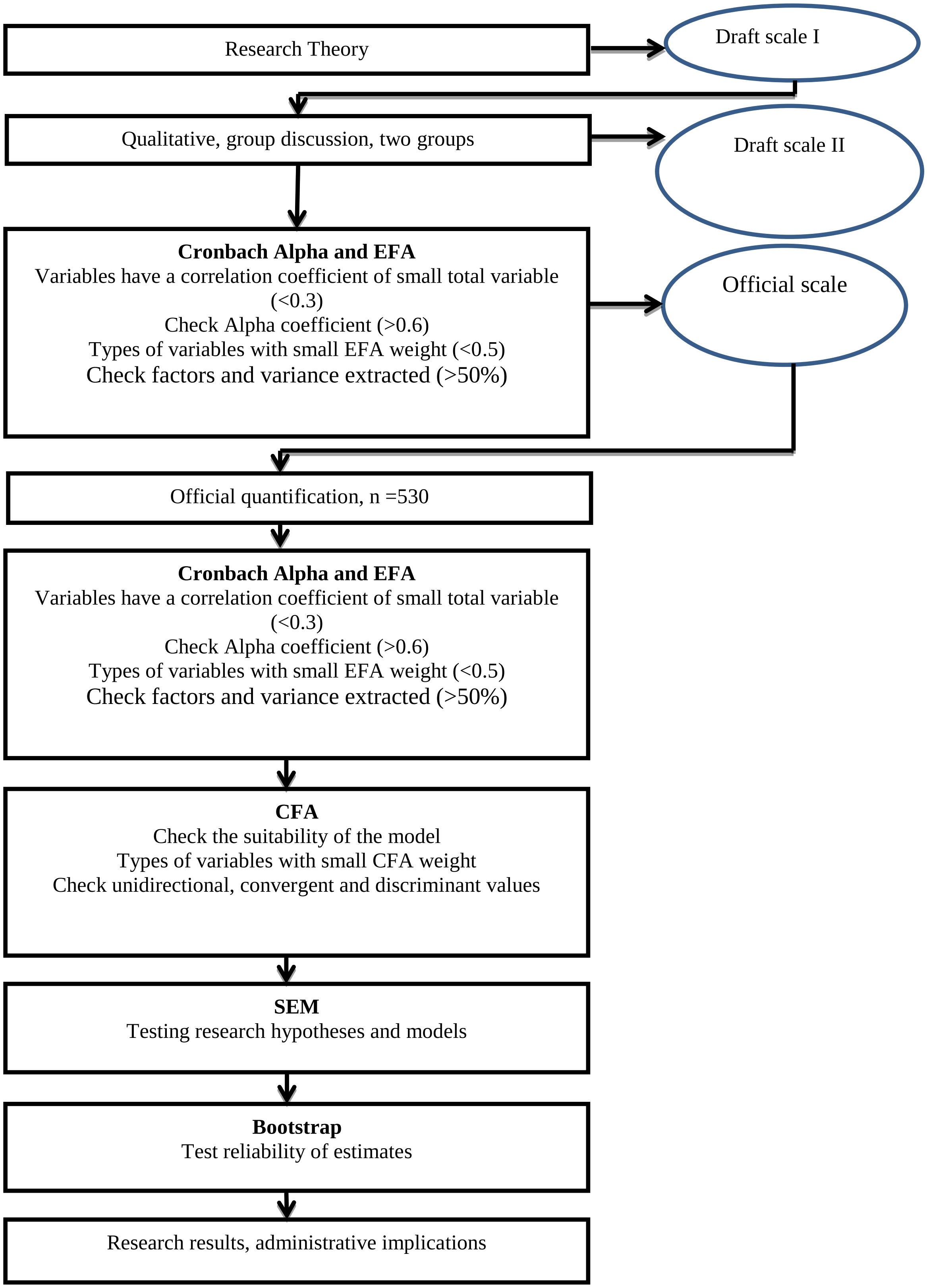

Figure 2 Research process

Methods of Sampling and Collecting and Processing Data in Preliminary Studies

1. Sampling Method

Sampling method for preliminary qualitative research: Sampling includes managers and operators of ports, berths, ICD with container operation and experts with in-depth research on ports in Vietnam Sampling method for preliminary quantitative research: selecting the sample size for this preliminary quantitative research step is 195 experts and managers focusing mainly on Ho Chi Minh City, Dong Nai, Binh Duong and Vung Tau (Table 10). Sampling method for official quantitative research step: researching with a sample size of 530 samples, through non-probability sampling method by convenient method.

Table 10 Statistics of official research samples

Area	Number of samples	Ratio %
South	435	82.07
Central	28	5.28
Northern	67	12.65
Total:	***530***	***100***

2. Data Collection Methods

A semi-standardized interview method with an open discussion outline was selected to collect the preliminary qualitative research step. Also, use the survey design with a closed questionnaire to collect data for preliminary quantitative research steps. In the preliminary quantitative research, the author issued 250 questionnaires directly to businesses, earning 195 satisfactory votes, in which 195 results were used for analysis. In the official quantitative research, the author emits 600 votes, obtaining 530 satisfactory votes for analysis. The survey-data processing tool: Data collected in quantitative research is entered into data, coded and processed, analyzed by SPSS-25 and AMOS-25 software.

3. Analyze Preliminary Quantitative Research Results

Theoretically, the characteristics of container ports are explained by six components: container port location, container port logistics, container port infrastructure, port's inland connectivity, container port dynamics, and port attractiveness. The port operation performance is explained by the three concepts of customer satisfaction, port operation, and port performance. However, this is only a preliminary study with the n = 195 with Varimax rotation and mainly the objects surveyed in Ho Chi Minh City, Vung Tau, Binh Duong and Dong Nai. Therefore, these scales need to be tested more closely with population n> 530 with Promax rotation, and the author will perform in the official research. Preliminary quantitative research results help determine the reliability of the scale and explain the initial research concepts. Still, some concepts of a very important nature are excluded in the preliminary quantitative research. The author decided to keep it for further development and survey in official quantitative research; if these concepts still do not satisfy reliability in official quantification, they will be eliminated.

Results and Discussions

Evaluating Reliability Scales the Concepts

Table 11 Assessing the reliability of scale of conceptual components

Variable code	Average scale	The variance of scales	Correlated total variable	Cronbach Federal Alpha if the variable type
Component scale 1: Logistics service of container ports, Cronbach's Alpha = 0,869				
L1	22.85	22.325	0.706	0.840
L3	22.65	22.874	0.675	0.845
L4	22.66	22.432	0.712	0.840
L6	22.86	22.345	0.567	0.861
L7	22.89	22.985	0.690	0.842
L8	22.78	23.125	0.706	0.841
L10	22.99	24.897	0.474	0.872
Component scale 2: Capacity to attract container ports, Cronbach ‘s Alpha = 0,878				
CA1	18.54	19.635	0.592	0.871
CA2	18.45	19.354	0.683	0.854
CA3	18.41	18.805	0.744	0.843
CA4	18.42	19.364	0.715	0.851
CA5	18.43	19.571	0.678	0.852
CA6	18.38	19.880	0.688	0.853
Component scale 3: Location of container port, Cronbach ‘s Alpha = 0,878				
Loc2	18.23	27.554	.685	.848
Loc3	18.28	28.054	0.628	0.857
Loc5	18.35	27.585	0.652	0.853
Loc6	18.18	28.184	0.661	0.851
Loc7	18.13	27.312	0.771	0.832
Loc9	18.20	27.436	0.648	0.854
Component scale 4: Container port infrastructure, Cronbach ‘s Alpha = 0,835				
Inf1	16.92	20.884	0.552	0.814
Inf2	16.93	20.921	0.513	0.822
Inf4	17.66	19.012	0.718	0.781
Inf5	17.61	18.867	0.736	0.775
Inf6	17.79	20.197	0.648	0.795
Inf7	16.88	21.494	0.466	0.831
Component scale 5: Inland port connectivity, Cronbach ‘s Alpha = 0,864				
Inl1	14.87	15.134	0.712	0.816
Inl2	14.92	15.645	0.672	0.825
Inl3	14.64	16.567	0.618	0.840
Inl4	14.68	15.412	0.707	0.818
Inl5	14.89	15.125	0.652	0.833
Component scale 6: Container port dynamics, Cronbach ‘s Alpha = 0,854				
Dyn1	10.89	10.451	0.735	0.778
Dyn2	11.21	10.308	0.665	0.817
Dyn3	11.13	10.589	0.645	0.818
Dyn4	11.01	10.390	.725	.787
Component scale 7: Container customer satisfaction, Cronbach ‘s Alpha = 0,755				
Sat1	7.46	4.968	0.587	0.656
Sat2	7.55	4.918	0.548	0.702
Sat3	7.49	4.968	0.588	0.658
Component scale 8: container terminal operation, Cronbach ‘s Alpha = 0,732				
Ter1	7.62	3.921	0.565	0.645
Ter2	7.70	3.778	0.524	0.684
Ter3	7.56	3.498	0.598	0.598
Component scale 9: Capacity of container ports, Cronbach's Alpha = 0,856				
Cap1	3.21	2.175	0.745	0
Cap2	3.24	2.012	0.745	0

Table 11 shows 9 components, including component one consists of 7 variables: L7, L1, L4, L8, L3, L6 and L10 to explain the organization of container port Logistics. The second component consists of 6 variables: CA3, CA2, CA5, CA4, CA6, and CA1 to explain container ports' attractiveness. The third component consists of 6 variables: Loc7, Loc2, Loc5, Loc6, Loc9, and Loc3 to explain the container port's position. Component four consists of 6 variables: Inf4, Inf5, Inf6, Inf1, Inf2, Inf7 to explain container port infrastructure. The fifth component consists of 5 variables: Inl1, Inl4, Inl2, Inl5, and Inl3 to explain container ports' inland connectivity. Component six includes 4 variables: Dyn4, Dyn1, Dyn2, Dyn3 to explain the dynamics of container ports. Component seven consists of 3 variables: Sat1, Sat3, Sat2 to explain container port customer satisfaction. Component eight consists of 3 variables: Ter3, Ter2, Ter1 to explain container port operation. The nine component consists of 2 variables: Cap1, Cap2 to explain the productivity of container ports.

As a result of rotating the factors, there is a clear focus on each observation. According to the analysis results, 42 observations are creating 9 factors. Factors are generally eligible for the follow-up analysis. After performing the EFA test for the factor scale, it was clear that the concentration of observations for each factor was quite clear. The analysis results table has 42 observations made up of 9 factors. The results also showed that the 6 extracted factor groups explained 54,791% of the data variation (> 50%), and the eigenvalues of the factors were greater than 1. Therefore using the factor analysis method is appropriate. Thus, the reliability of the scale of extracted components with Cronbach's Alpha is> 0.6, and the correlation coefficients are> 0.5. Therefore, the scales ensure the intrinsic stability in the observed variables to measure research concepts.

Testing the Research Model

After confirming factor analysis, the study used a linear structure model to determine the factor relationship and the influence of each factor of port characteristics on container port operation efficiency. Analysis of linear structure model (SEM) was conducted from the initial proposed research model, followed by adjustments to obtain a better model. The result of SEM shows that Chi-squared = 1270.539 with the value P = .000, df = 803, Chi-square / df = 1.582; CFI = 0.950; TLI = 0.946; RMSEA = 0.034. It should be compatible with market data collection. The results shown in the figure 3 can be said that the model is consistent with the research data because Chi-square / df = 1.582 <2; TLI, CFI> 0.9; GFI ≈ 0.9, RMSEA = 0.034 (<0.08). After reviewing the model's suitability, the next issue will evaluate the SEM analysis results shown in Table 12. The estimated results show that the relationships are statistically significant with P <0.05, but there is a relationship with P = 0.093> 0.05 that can accept this hypothesis with a confidence of 90 %.

Table 12 Results of the estimated scale affecting port characteristics to the efficiency of container port operation

Relationship			Not standardized				Normalized (ML)
			ML	SE	CR	P	
Performance	<---	Characteristic	1.474	0.242	6.112	-	1.046
L	<---	Characteristic	0.502	0.073	3.113	-	0.432
CA	<---	Characteristic	0.416	0.074	5.578	-	0.431
Lo	<---	Characteristic	0.382	0.086	4.392	-	0.297
Inf	<---	Characteristic	0.306	0.081	3.827	-	0.252
Inl	<---	Characteristic	0.294	0.076	3.883	-	0.255
Dyn	<---	Characteristic	0.528	0.092	5.692	-	0.446
Sat	<---	Characteristic	0.502	0.044	3.112	-	0.451
Ter	<---	Characteristic	0.262	0.054	4.756	-	0.364
Cap	<---	Characteristic	0.116	0.068	1.675	0.092	0.105

Testing Research Hypotheses

Figure 3 illustrated the results of the model affecting port characteristics affecting the efficiency of container port operation. The study has 10 hypotheses, with the results of testing by SEM tool as follows:

Firstly, hypothesis H1.1 with the statement "Infrastructure is a characteristic of container ports". The testing results show that with the standard deviation level (SE) = 0.080, P = *** value <0.05 should be statistically significant at the 95% confidence level. Therefore, this hypothesis is accepted, and this means that infrastructure is a characteristic of container ports. With an estimate of 0.251, it can be said that the characteristics of a container port include the port infrastructure system.

Secondly, hypothesis H1.2 with the statement "Port location is a characteristic of container port". The testing results show that with the standard deviation (SE) = 0.087, the P = *** value <0.05 should be statistically significant at the 95% confidence level. Therefore, this hypothesis is accepted, and this means that infrastructure is a characteristic of container ports. With an estimate of 0.298, it can be said that the characteristics of a container port include its location.

Thirdly, hypothesis H1.3 with the statement "Domestic connectivity is a characteristic of container ports". The testing results show that with the standard deviation level (SE) = 0.075, the P = *** value <0.05 should be statistically significant at the 95%

confidence level. Therefore, this hypothesis is accepted, and this means that infrastructure is a characteristic of container ports. With an estimate of 0.2559, it can be said that the characteristics of a container port include inland port connectivity.

Fourthly, hypothesis H1.4 with the statement "Port dynamics is a characteristic of container ports". The testing results show that with the standard deviation level (SE) = 0.093, P = *** value <0.05 should be statistically significant at the 95% confidence level. Therefore, this hypothesis is accepted, and this means that infrastructure is a characteristic of container ports. With an estimate of 0.447, it can be said that the characteristics of container ports include port dynamics.

Fifthly, hypothesis H1.5 with the statement "attractiveness is a characteristic of container ports". The testing results show that with the standard deviation level (SE) = 0.075, the P = *** value <0.05 should be statistically significant at the 95% confidence level. Therefore, this hypothesis is accepted, and this means that infrastructure is a characteristic of container ports. With an estimate of 0.430, it can be said that the characteristics of a container port include its attractiveness.

Sixthly, hypothesis H1.6 with the statement "Logistics services is a characteristic of container ports". The testing results show that with the standard deviation level (SE) = 0.071, P = *** value <0.05 should be statistically significant at the 95% confidence level. Therefore, this hypothesis is accepted, and this means that infrastructure is a characteristic of container ports. With an estimate of 0.430, it can be said that the characteristics of container ports include port logistics services.

Seventhly, hypothesis H2 states that "container port characteristics have a positive impact on container port operation efficiency". This hypothesis means that if a container port has good, appropriate and favourable port characteristics, it will increase container port operation efficiency. The testing results show that with the standard deviation (SE) = 0.241, the P-value = 0.000 <0.05 should be statistically significant at the 95% confidence level. Therefore, this hypothesis is accepted, which means that the characteristics of container ports positively impact container port operation efficiency.

Eighthly, hypothesis H3 with the statement "port customer satisfaction is a measure of the efficiency of container port operation". This hypothesis means that the performance of a container terminal is measured by port customer satisfaction. The testing results show that with the standard deviation (SE) = 0.043, the P-value = 0.000 <0.05 should be statistically significant at the 95% confidence level. Therefore, this hypothesis is accepted, and this means that container port operation efficiency is measured by port customer satisfaction. With an estimate of 0.450, it can be said that port customer satisfaction is a measure of container terminal operation efficiency.

Ninthly, the hypothesis H4 with the statement "port capacity and efficiency is a measure of container terminal efficiency". This hypothesis means that the performance of a container port is measured by productivity and port performance. Test results show that with standard deviation (SE) = 0.069, P-value = 0.093> 0.05 can accept this hypothesis with a confidence level of about 90%. This means that container port operation efficiency is measured by port performance and performance. With an estimate of 0.108, it can be said that the port's productivity and performance is a measure of container terminal operation efficiency container.

Finally, hypothesis H5 states that "port operation is a measure of container terminal efficiency". This hypothesis means that its port operation measures the performance of a container terminal. Test results show that with standard deviation (SE) = 0.055, P = 0.000 <0.05 can accept this hypothesis with 95% confidence level. This means that the port operation measures container port operation efficiency. With an estimation of 0.363, it can be said that port operation is a measure of container terminal operation efficiency.

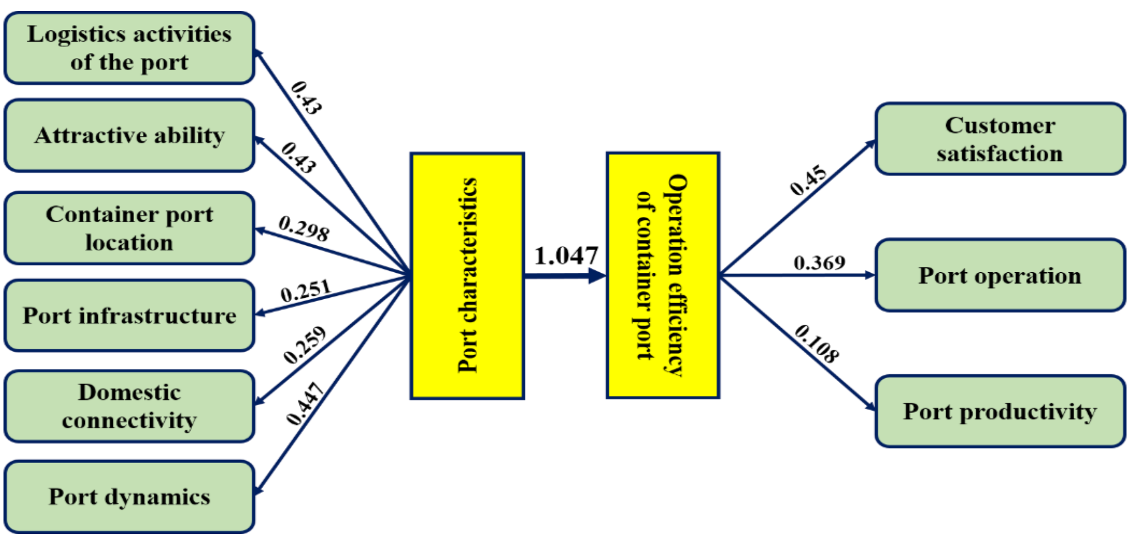

Figure 3 The estimated result of the impact of port characteristics on container port operation efficiency

Conclusion

This study specifically measures the concepts of port characteristics affecting the efficiency of container port operation in Vietnam as follows:

Container port location is a port feature that affects the efficiency of container port operations. This factor has a corresponding weight of 0.298, which means whether a container port operates effectively or not due to the port's location.

Container port dynamics is a port characteristic that affects container port operation efficiency. This factor has a weight of 0.447, which means that the more dynamic a container port is, the higher its operating efficiency is. The dynamics of container ports include container terminal and dynamic port logistics. A dynamic port in the management work will be active in exchanging information with customers.

Inland connectivity is a port characteristic that affects the efficiency of container port operations. This factor has a weight of 0.25, which means that a port with high domestic connectivity will be more effective. There are more roads to the port, the greater the port's connectivity to the domestic logistics networks. Moreover, the transport capacity of logistics companies in the region is large, connecting river and road networks into container yards, with many river routes to the port.

Attractive capacity is a port characteristic that affects container terminal operation efficiency. This factor has a weight of 0.43, which means that the higher the container port's capacity, the higher the port operating efficiency.

Infrastructure is a port characteristic that affects the efficiency of container port operations. This factor in the number of 0.25 means that a port with good infrastructure will be a condition for efficient operation and improve competitiveness.

Organizing logistics services is a port characteristic that affects the efficiency of container port operation. This factor has a weight of 0.43 which means that a port will increase its operating efficiency if it knows how to organize a good logistics service.

In summary, with the research results from the initial research proposal model, it can be confirmed that port customers' satisfaction measures container port operation efficiency. These include the satisfaction of import and export cargo owners, container shipping lines, import and export freight forwarders; port performance, including port productivity, performance; port operations include many sources of goods entering and leaving the port, the number of containers transshipped at the big port, the frequency of ships calling at the port more; The operation is affected by port characteristics including 6 characteristics: location, dynamics, attractability, inbound connectivity, infrastructure, and organization of logistics services.

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Conflicts of Interest

The authors declare that they have no interest in reporting regarding the present study.

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