

A Study on Port Improvement with the Activation of Cross-Border E-Commerce: A Study of Pyeongtaek Port

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Abstract

Purpose – The purpose of this study is to present what the port of Pyeongtaek, the hub of Korean trade with China, should improve in the current situation, wherein the e-commerce trade volume between Korea and China is increasing due to the development of online technology.

Design/methodology – In this study, through prior research and expert interviews on e-commerce and port activation between borders, we derived the main improvement factors for 1) Administration and Systems, 2) Facilities, 3) Transport, and 4) Manpower, and selected 12 detailed variables for the major improvement factors. To identify the relative importance of the major improvement factors, the Analytic Hierarchy Process (AHP) method was applied, and a survey was conducted among 15 related experts.

Findings – As a result, among the 12 detailed variables, Composition of Association (0.267) was the first factor to be improved, followed by Incentive Support (0.143) and E-Commerce Cluster (0.131). Based on these analyses, the main implications of this study are, first, in the current situation where the cross-border e-commerce market is growing, Pyeongtaek Port needs to form a consultative body among the government, local governments, and related businesses in connection with cross-border e-commerce and develop various support policies for the e-commerce market. Second, it will have to be able to provide differentiated services from competing ports by establishing e-commerce market-oriented clusters.

Originality/value – In existing related studies, various improvements were presented to revitalize trade in line with the growth of the cross-border e-commerce market. However, with regard to most cross-border e-commerce businesses, one-dimensional improvement measures, such as improvement of payment systems, improvement of customs clearance services, and promotion of human resources, are presented in a piecemeal manner. In other words, none of the studies have proposed the importance and priority of each measure in terms of both the forward-looking and efficient allocation of resources, which is the purpose of this study. Therefore, this study contributed politically, practically, and academically by presenting countermeasures for ports to revitalize cross-border e-commerce and presenting strategic priorities using quantitative analysis methods.

Keywords: Analytic Hierarchy Process (AHP), Cross-border E-commerce, Improvement Factors of Port, Priority, Pyeongtaek Port

JEL Classifications: F14, L91

1. Introduction

E-commerce refers to all commercial transactions made online, which encompasses all transactions for products and services traded online. These services include a wide range of business areas such as advertising, marketing, and customer support. E-commerce is typically

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implemented through a business-to-consumer (B2C) model, wherein companies sell products or services to individual consumers. With the recent spread of the internet and mobile phones, cross-border e-commerce online has been rapidly growing as a new form of trade. In particular, with the advent of global open markets engaged in online businesses, including Amazon, eBay, and Alibaba, the number and amount of e-commerce transactions across borders is increasing each day. Although there is no established definition of cross-border e-commerce, various existing definitions can be summarized as follows. E-commerce refers to a new form of import–export activity wherein exporters trade goods directly with foreign consumers online without the mediation of importers in other countries.

Recently, due to the development of the e-commerce infrastructure and the convenience of the global payment method, B2C e-commerce between countries where foreign consumers order directly through the Internet is increasing rapidly (Lee Jun-Bong and Nam Kyung-Doo, 2016).

Patrikios (2008) predicted that although cross-border e-commerce accounted for 12% of the B2C e-commerce market, this type of e-commerce would rapidly grow at an annual average growth rate of 17%, with \$627 billion revenue. In particular, this study forecasted that import–export through e-commerce would increase in the Asia–Pacific region, dominated by China, faster than other regions.

In South Korea, the widespread use of online shopping by individual consumers has evolved into a trend of e-commerce across borders. In 2017, direct purchases from overseas sellers in South Korea reached 23.59 million transactions, approximately \$2.1 billion in transaction value. The number of transactions increased by 35.6%, and the transaction value rose by 29.1% compared to 2016. Choi Seok-Beom (2005) noted that cross-border e-commerce has been actively promoted in Northeast Asia. In particular, the conclusion of the Korea–China Free Trade Agreement (FTA) had an insignificant impact on e-commerce trade between the two countries in the short term, while its mid- and long-term impact resulted in promoted e-commerce trade between the countries, including the increased trade and lowered non-tariff barriers.

As such, it is international transport that plays an essential role in the rapid growth of cross-border e-commerce, and the role of ports and airports as major hubs of international transportation is recognized as significant (Shin Sung-Ho, Jung Hyun-Jae and Lee Dong-Hyon, 2018). Specifically, in the case of ports, due to the nature of e-commerce cargo between borders, cargo used only for air transportation has been recognized as a new business model because it has been partially converted into sea transportation since 2015. It is necessary to explore ways in which the port logistics process in line with this situation can be improved.

As a result, the Korea–China FTA framework and the growth of China’s e-commerce market are expected to affect not only aviation but also the shipping and port logistics sectors amid the global low growth trend. Thus, in this study, we aim to analyze the primary factors and draw implications using the AHP technique for the improvement of Pyeongtaek Port, which is a base port for trade between China and Korea, alongside the development of e-commerce.

2. Background and Literature Review

2.1. Cross-Border E-Commerce between Korea and China

The development of e-commerce between South Korea and China began in the 2000s. At that time, South Korea and China held a high-level working meeting on e-commerce, and successive conferences led to the conclusion of the Korea–China FTA in 2015, in addition to

the development of e-commerce between the two countries (Kshetri, 2017). Furthermore, e-commerce freight through ocean shipping first began in 2015 through ferry shipping between Incheon and Qingdao, and later, since the Korea Post provided the Korea–China Sea Express Service, the ocean shipping for e-commerce between the two countries has been carried out through container and ferry shipping. To handle cross-border e-commerce freight through ocean shipping, the role and function of ports and port hinterland complexes are highly important, and the establishment of related infrastructure is urgently required.

However, Pyeongtaek Port, the subject of this study, lacks in varied aspects, such as related infrastructure. In particular, e-commerce freight transactions in relation to China handled through Pyeongtaek Port amounted to approximately 400,000 in 2017, about five times higher than those in 2015. However, problems have been occurring, such as unnecessary transportation to Incheon Port owing to the absence of a customs clearance place to handle e-commerce freight

2.2. Previous Studies on Cross-Border E-Commerce

The development of computer and internet technologies has promoted cross-border e-commerce (Valarezo et al., 2018), and international trade is expected to increase in size through cross-border e-commerce (Terzi, 2011). Thus, various studies have been conducted on cross-border e-commerce. A study by Gomez-Herrera, Martens and Turlea (2014) predicted that cross-border e-commerce would significantly reduce trade costs, noting that an efficient and flexible international payment system would be important for the promotion of e-commerce. Similarly, a study by Savrul, Incekara and Sener (2014) maintained that cross-border e-commerce could play an important role in increasing the sales of mid-sized companies, though online security issues and other hurdles, such as legal and regulatory issues present in payment systems, and argued that technology development and deregulation should be facilitated in cooperation between the government and companies. Hsiao, Chen and Liao (2017) argued that cross-border e-commerce companies need to continuously differentiate logistics services in an environment exposed to increasingly diversified and complex demands from customers. Gessner and Snodgrass (2015) noted that cross-border e-commerce was growing at a faster rate than conventional trade, and was an important market for companies to create new opportunities. However, Gessner and Snodgrass (2015) further pointed out that customs and tariff systems were acting as barriers to conducting business across borders, and that negotiations between countries were required to alleviate these barriers, including tax exemptions between countries. Most of the previous studies reviewed thus far have suggested institutional problems, and have provided improvement plans in relation to payment systems and customs clearance in the cross-border e-commerce business. In contrast, in a situation where cross-border e-commerce freight through ocean shipping has increased in recent years, no previous studies have dealt with the role and major approaches of ports to attract cross-border e-commerce freight.

In addition, in a study on the activation plan of cross-border e-commerce in terms of port logistics, Yu Kwang-Hyun (2017) revealed that it was time to develop strategies for the activation for imports and exports in Korea because China has grown as a significant market in the cross-border e-commerce market, and strategically proposed smoother e-commerce import and export customs clearance between borders and the expansion of marine transportation.

Kim Jong-Gil (2017) also recognized China as a major hub of e-commerce and claimed that e-commerce cluster creation was necessary to revitalize cross-border e-commerce business at ports.

Furthermore, Li Tianyun (2018) also suggested that it was possible to build an industrial cluster using a logistics complex as one of the backgrounds for the development of China's Chongqing region as a significant base of e-commerce between borders. In other words, building a cluster is one of the most critical strategies for revitalizing the industry, and is recognized as vital infrastructure for revitalizing cross-border e-commerce at ports as well.

Additionally, Wu Guang-Ming (2016) indicated that for cross-border e-commerce to be fully activated, it is necessary to foster comprehensive human resources by establishing related education, research, and training systems. Chen Xuhua (2019) also pointed out that cross-border e-commerce through sea transportation was active, but less efficient due to delays in customs clearance inspections at the ports, arguing that improvement was needed.

On the basis of the above studies, essential tasks related to cross-border e-commerce activation are as follows.

First, the quality of services should be improved by establishing related clusters. Second, smooth customs clearance, which is a significant service indicator in international logistics, should be realized. Third, it is necessary to expand the maritime transport service route so that e-commerce cargo between borders through sea transportation can be exported quickly. Fourth, it is necessary to foster a professional workforce that can specialize in cross-border e-commerce services and related cargo.

Studies that have been discussed so far have suggested various measures to promote cross-border e-commerce in terms of port logistics. However, most studies fragmentarily suggest one-dimensional improvement plans to boost cross-border e-commerce.

In other words, no research proposes importance and priority for each measure in terms of the overall aspect and the efficient allocation of resources limited to ports. Therefore, this study presents countermeasures for the ports to activate cross-border e-commerce and suggests strategic priorities by employing quantitative analysis methods.

3. Research Design

3.1. Analytic Hierarchy Process

In this study, the AHP technique was employed to analyze the importance of significant improvement factors for Pyeongtaek Port due to the activation of e-commerce between borders. AHP is a decision-making method for capturing expert knowledge and experience (Satty, 1977). In this sense, it is a method for researchers involved in studies to quantitatively address problems by comparing multiple factors and evaluating the priorities of the multiple factors based on their knowledge and experience, showing advantages in deriving relative weights through pairwise comparison (Satty, 1980).

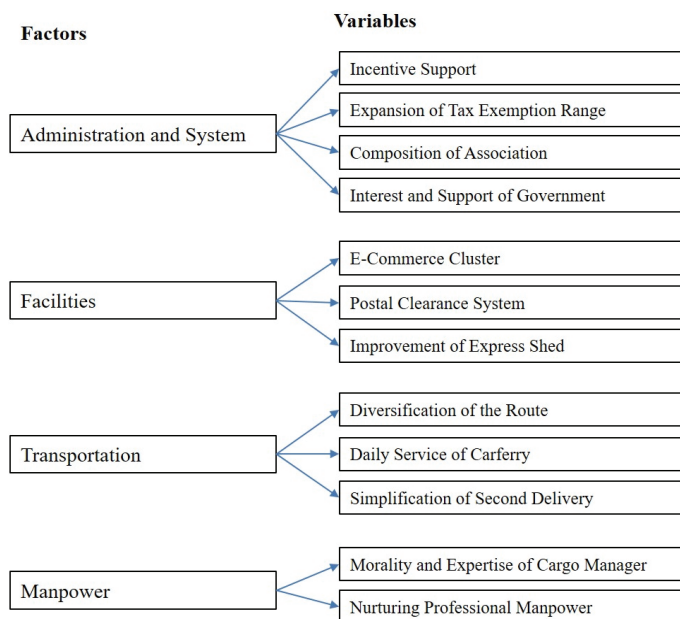
AHP is performed through the following analysis process. First, to make a decision about a complex problem, related factors are stratified, which requires a process of creating higher-level factors by clustering the variables influencing the decision. Second, a pairwise comparison of decision-making variables is performed, which grants a weight to each variable on a 9-point scale. The relative importance is derived from this pairwise comparison process. Lastly, the consistency in the responses of respondents is verified, which validates the significance of the analysis in general statistical analysis. Thus, AHP can be used to verify consistency through the consistency ratio using the consistency and random indices, typically determining that the consistency of the response is appropriate when the consistency is 0.1 or less.

3.2. Key Factors

In addition to the significant activation factors suggested in prior studies, additional

improvement factors were examined through interviews with experts in charge of cross-border e-commerce-related business at Pyeongtaek Port in this study. The experts consisted of five people directly responsible for work at shipping companies, customs offices, and e-commerce-related couriers. Through one-on-one interview surveys, the following improvement factors were extracted.

Fig. 1. Hierarchy Structure of Improvement Factors



This study has derived 12 major improvement variables through interviews with experts, and stratified the variables into four higher-level factors in consideration of the characteristics of the variables. Administration and System factors have four detailed variables. Incentive support is a typical support plan that can attract cross-border e-commerce companies to Pyeongtaek Port. The expansion of the tariff exemption is currently at \$150 for cross-border e-commerce cargo; because orderable items are limited at the current level, it is necessary to raise the tariff range to increase the volume of goods.

Furthermore, to listen to the difficulties of the market participants and promptly resolve related problems, establishing a permanent association between relevant agencies along with government attention and support to enable sea express services between South Korea and China at Pyeongtaek Port, which commonly occur at Incheon Port.

In terms of facilities, it is necessary to provide one-stop services with cross-border e-commerce services, and to create related clusters for logistics cost reduction and job creation. Moreover, it is necessary to establish a postal customs clearance system that enables smooth secondary delivery using the national network held by the Korea Post. Finally, an express shed is needed to handle cross-border e-commerce cargo.

In terms of transportation, China currently operates an e-commerce pilot zone, and it is necessary to seek diversification of Pyeongtaek Port's routes to China for ocean shipping to each region. Further, because most e-commerce cargo between Korea and China borders are

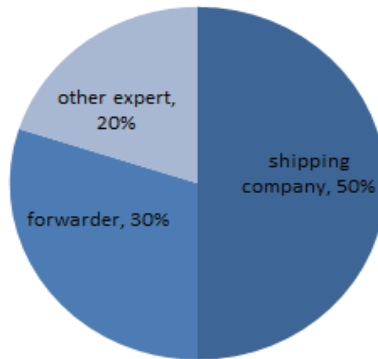
imported and exported through car ferry, it is necessary to expand the Korea–China car ferry route to Pyeongtaek Port. A secondary delivery system should also be systematically established to ensure that freight coming into and out of the port can be promptly transported inland.

Lastly, in terms of manpower, the expertise and morality of the freight manager will be required to prevent cargo damage and to ensure smooth customs clearance in the cross-border e-commerce freight yard. To activate e-commerce between borders, it is necessary to cultivate professional human resources for global sellers, MDs, and the marketing and promotion of products.

3.3. Survey

For the analysis of this study, a survey was conducted with 15 experts presently in charge of cross-border e-commerce exports and imports in Pyeongtaek Port. This survey was conducted through e-mail and face-to-face interviews which lasted approximately one month from February 2019.

Fig. 2. The Occupations of the Respondents



4. The Results of AHP Analysis

This study, as mentioned previously, divided the major improvement factors into higher-level factors and detailed variables and stratified the factors, primarily determining the priorities of higher-level factors as below.

Table 1. Factor Weights

Factor	Weight	Inconsistency
Administration and System	0.555	0.080
Facilities	0.274	
Transportation	0.097	
Manpower	0.075	
Sum	1.000	-

As a result of analyzing the importance of the four top factors, it was found that a need to overhaul the administrative and institutional system (0.555) prevailed among the significant improvements at Pyeongtaek Port due to the activation of e-commerce between borders.

The importance was then calculated in the order of infrastructure development and maintenance related to cross-border e-commerce (0.274), maintenance of marine and land transport systems (0.097), and maintenance (0.075) for the related personnel; these results are slightly different from the results presented in the previous studies.

In the previous studies, improvement measures related to infrastructure maintenance were proposed to revitalize e-commerce between borders in terms of logistics and port, while administrative and institutional readjustment were prioritized in this study. This is opinionated due to the differences in perceptions related to the significance of cross-border e-commerce and insufficient institutional support compared to foreign countries concerning cross-border e-commerce.

Subsequently, the priorities of variables in terms of administration and system were determined as follows.

Table 2. Weights of Administration and System Variables

Variable	Weight	Inconsistency
Incentive Support	0.242	
Expansion of Tax Exemption Range	0.120	0.080
Composition of Association	0.450	
Interest and Support of Government	0.187	
Sum	1.000	-

An analysis of the importance of the four variables in terms of administrative and institutional aspects has revealed that the most crucial factor is to form a consultative body of relevant organizations and businesses to activate cross-border e-commerce (0.450).

Further, incentive support (0.242) of metropolitan and basic municipalities was analyzed to be vital, and the importance was calculated in the order of interest and support by the government (0.187) and expansion of tariff exemption range (0.120) so that e-commerce between borders could be activated in Pyeongtaek Port. Incheon Port, which is currently a rival of Pyeongtaek Port, has formed a consultative body made up of related organizations, such as shippers and shipping companies, to promote e-commerce between borders.

The council is seeking ways to boost cross-border e-commerce as a new business model for Incheon Port. Pyeongtaek Port will also need a strategic consultative body to recognize the importance of the cross-border e-commerce market as a new business model, and to prevent related cargo from escaping to the competitive Incheon Port. Further, the importance of three variables on e-commerce between borders was analyzed as follows.

Table 3. Weights of Facilities Variables

Variable	Weight	Inconsistency
E-Commerce Cluster	0.452	
Postal Clearance System	0.315	0.003
Improvement of Express Shed	0.233	
Sum	1.000	-

Concerning infrastructure, the establishment of a cross-border e-commerce cluster (0.452) was selected as the most critical factor for the promotion and efficient management of cross-border e-commerce, followed by the establishment of a postal clearance system to attract the Korea Post, who holds the national network (0.315), and the importance was calculated in the order of operation (0.233) of the storage responsible for customs clearance of cross-border e-commerce cargo. It is thus necessary to build a cluster that can provide one-stop service within the port as an essential way to create cargo volume and increase service.

Kim Jong-Gil (2017) and Li Tianyun (2018) have also argued that it is necessary to secure a logistics base with clusters to activate cross-border e-commerce. In other words, Pyeongtaek Port needs to attract e-commerce-related companies to the port hinterland and simultaneously provide one-stop services related to imports and exports; it is therefore necessary to attract companies that can collect and distribute cross-border e-commerce goods, alongside warehouse facilities for performing customs clearance and inspection at Pyeongtaek Port. Moreover, institutional support measures should be sought to attract related businesses.

The priorities of the three improvement factors in terms of transportation were determined as follows.

Table 4. Weights of Transportation Variables

Variable	Weight	Inconsistency
Diversification of the Route	0.227	
Daily Service of Carferry	0.648	0.010
Simplification of Second Delivery	0.126	
Sum	1.000	-

In terms of transportation, the improvement of daily services of the Korea–China ferry routes opened at Pyeongtaek Port (0.648) was determined as the most important factor, followed by the diversification of the routes toward the inland regions located within the e-commerce pilot zone in China (0.277), and simplification of second delivery for promoting inland shipping (0.126).

In general, cross-border e-commerce cargo has been imported and exported by air transport; however, due to high transportation costs, exports and imports using car ferry transportation are increasing. Currently, Pyeongtaek Port operates five car ferry routes with China, but most of the routes are operated three times a week. Hence, it is inconvenient to transport in accordance with the time demanded by the shippers.

Therefore, it is necessary to increase the number of operations of the car ferry route and seek strategic alliances between car ferry carriers so that shippers can transport at the desired time. Furthermore, as revealed in Yu Kwang-Hyun (2017), it is necessary to establish diverse routes based on actual requirements to boost cross-border e-commerce with China.

Lastly, the priorities of the three improvement factors at Pyeongtaek Port in terms of manpower were determined as follows.

Table 5. Weights of Manpower Variables

Variable	Weight	Inconsistency
Morality and Expertise of Cargo Manager	0.696	0.010
Nurturing Professional Manpower	0.304	
Sum	1.000	-

Among the factors for improving cross-border e-commerce in terms of workforce, the expertise and morality of management personnel engaged in cross-border e-commerce cargo units (0.696) were selected as a crucial factor. Further, the need to nurture professional human resources related to cross-border e-commerce was recognized (0.304). Daily laborers conduct cargo handling in harbors without professional knowledge, and hence, cargo damage and loss of cargo occurs frequently.

However, cross-border e-commerce cargo is a small category of goods and is mainly expensive, and thus more professional handling is required. These results are the same as the importance of human resources presented in Wu Guang-Ming (2016). This means that it is necessary to cultivate a professional workforce immediately to handle cross-border e-commerce cargo for cross-border e-commerce activation.

Based on the above weights of higher-level factors and the detailed variables by factor, the overall weights of the 12 variables were calculated, which resulted in the following priorities.

Table 6. Composite Importance of Variables

Factor	Weight(A)	Variable	Weight(B)	Importance
Administration and System	0.555	Incentive Support	0.242	0.143
		Expansion of Tax Exemption Range	0.120	0.071
		Composition of Association	0.450	0.267
		Interest and Support of Government	0.187	0.111
Facilities	0.274	E-Commerce Cluster	0.452	0.131
		Postal Clearance System	0.315	0.090
		Improvement of Express Shed	0.233	0.063
Transportation	0.097	Diversification of the Route	0.227	0.016
		Daily Service of Carferry	0.648	0.047
		Simplification of Second Delivery	0.126	0.009
Manpower	0.075	Morality and Expertise of Cargo Manager	0.696	0.036
		Nurturing Professional Manpower	0.304	0.016

Note: Importance = Weight(A) × Weight(B).

To promote cross-border e-commerce, Pyeongtaek Port should initially form a consultative body among the Regional Office of Oceans and Fisheries, customs, local governments, and related companies. Metropolitan and local governments will have to seek ways to provide incentives for cross-border e-commerce-related companies for the usage of the port. It should also be able to create clusters and provide differentiated services from other ports so that they can receive professional services related to cross-border e-commerce.

5. Conclusion

This study aimed to identify improvements that need to be undertaken at Pyeongtaek Port and suggest implications at the present when e-commerce between Korea and China is active. To derive major improvement factors, this study analyzed priorities using the AHP technique, and the findings are as follows. First, four higher-level factors were set by stratifying 12 variables, and the administration and system factor (0.555) was derived as the most important. According to the determined priorities of variables by each factor, the

composition of association (0.450) was determined as the most prioritized in the administration and system factor. Similarly, the major improvement factors include the establishment of an e-commerce cluster (0.462) in the facilities factor, and the realization of daily service of a car ferry (0.468) in the transportation factor. Finally, the morality and expertise of cargo managers (0.696) was determined the most prioritized improvement factor in manpower. Furthermore, according to the determined overall weights in consideration of priorities of higher-level factors and variables, it was proposed that Pyeongtaek Port urgently needs to form a consultative academic-industrial-governmental research association related to cross-border e-commerce to discuss pending issues and seek improvement measures. According to other findings, it is necessary to attract shippers in Gyeonggi-do and Pyeongtaek-si by supporting incentives and establishing an e-commerce cluster to lay a foundation to provide one-stop services to customers, such as shippers.

On the basis of the results of the aforementioned analysis, this study tries to suggest the following implications. First, Pyeongtaek Port needs to form a consultative body to activate e-commerce between borders, and customs authorities should consult with China on customs clearance concerning e-commerce. Furthermore, customs clearance systems, along with the expansion of tax range, should be improved. The Pyeongtaek Regional Office of Oceans and Fisheries should take the lead in adjusting the schedule allowing ferry carriers to provide daily services and further strengthen maritime services. Gyeonggi province and Pyeongtaek city should devise measures to enable related companies to use Pyeongtaek Port, including setting up incentive support standards for companies performing cross-border e-commerce business. Academic circles should conduct research, such as system improvements and strategic suggestions to ensure smooth import and export of e-commerce cargo between borders at Pyeongtaek Port.

Second, as e-commerce between Korea and China progresses every year, the need for an e-commerce business model is also increasing at the port. However, the basic infrastructure and service systems related to cross-border e-commerce have not been established at present at the port. Currently, the cross-border e-commerce shipments are being transferred to Incheon Port. Therefore, the establishment of a cross-border e-commerce cluster which can provide total logistics services, such as maritime, inland transportation, and customs clearance services, is believed to prove essential to prevent such a transition phenomenon.

Furthermore, Pyeongtaek Port should be fostered as a global e-commerce logistics hub, and it should find ways to contribute to the local economy by creating high-quality jobs while seeking to activate imports and exports.

As mentioned above, nothing has been studied on the role and improvement measures of ports related to cross-border e-commerce. Therefore, this study can be used as a basis for Pyeongtaek Port to successfully establish an e-commerce business model. However, data were collected from only a few experts in this study. Thus, future studies should use a larger sample of subjects with broader knowledge, such as related corporations.

Moreover, this study has a limitation in which more detailed and quantitative analysis is insufficient because the statistical index related to the AHP analysis method is not provided; only the main improvement measures are derived by using the AHP analysis method to activate the cross-border e-commerce and attract related cargo at ports. Therefore, future studies should be conducted to complement this shortcoming.

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