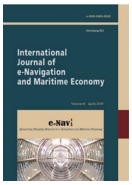
e-Navi

Available online at http://www.e-navi.kr/
e-Navigation Journal



Original article

The Priorities of Influencing Determinants for Dry Port Competitiveness in the North and the South of Vietnam – An AHP and IPA Approach

Thu Trang NGUYEN[a], Hong Gyue PARK[b]

[a]Chungnam National University, nguyenthutrang.ip@gmail.com

[b] Chungnam National University, Korea, ny1525@cnu.ac.kr, Corresponding Author

Abstract

To operate a dry port effectively and efficiently, strengthening the competitiveness of dry ports could be the key to bring notable improvements during operational activities and to increase the attraction of dry ports. This paper aims to discover the prioritization of the influential determinants of dry port competitiveness in the north and the south of Vietnam through an analysis based on expert judgments and customer evaluations. With a comprehensive literature review of previous studies equal to investigation results gained from several intensive interviews, many variables are adopted as potential factors that may enhance the competitiveness of dry ports in Vietnam. Through the AHP and IPA approach, this study sketches several development strategies for dry ports and provides important insights for governments by encouraging and supporting policies for the proper operation of dry ports. In the AHP analysis, cost was found to be the most important factor to improve dry port development in Vietnam, and transportation connectivity and cost are more prioritized in the north, with the remaining important determinants for dry port competitiveness receiving more attention in the south of Vietnam.

Keywords: Dry Port, Competitiveness, Priorities, Influencing Determinants, Vietnam

Peer review under responsibility of Korea Advanced Institute for International Association of e-Navigation and Ocean Economy
The authors specially thank to board of directors of ICD Long Thanh ICD, ICD Hai Duong, Vietnam National Shipping Lines, Vietnam Transport and Development Strategy Institute and all supporters for providing precious information and significant evaluations for this paper.
https://doi.org/10.52820/j.enavi.2021.17.026

1. Introduction

The appearance of dry ports is basically referred as a latter phase of the seaport-dry port system development (Fatimazahra et al., 2016), in which dry port acts like extended arm, utilizes intermodal transportation and provides similar functions as they can be performed usually in seaports, but in the hinterland. As a result, it can be a logistics node that can support the seaport operation, decrease the congestion and enhance the logistics performance in the supply chain. Dry port concept first appeared in Vietnamese economy through the establishment approval of inland container depot (ICD) GiaThuy (1996 - in the North of Vietnam) and ICD Dongnai (1998 – in the South of Vietnam) (TSDI, 2016). The number of dry ports in Vietnam has been increasing through years, and it is expected to reach 32 dry ports in entire the country until 20301.

This raise also leads to the severe competition in the market, therefore, the demand to find comprehensive solutions to enhance dry port competitiveness strengthen the advantages and weaken the disadvantages increases obviously. Nevertheless, the articles examined the competitiveness of dry ports are scarce, especially for Vietnam market. Therefore, the present paper firstly aims at exploring the potential determinants and the priorities of these factors for dry port competitiveness in two specific geographical areas in Vietnam (the North of Vietnam and the South of Vietnam) by utilizing the expert assessment (via AHP approach), and secondly based on the customer evaluation, the paper also examines the difference between the current importance level and the corresponding performance degree of each determinant (via IPA approach).

2 Dry port in Vietnam and Research Model

2.1 Dry port in Vietnam

According to a plan report of Transport Development and Strategy Institute(2016), dry ports have appeared in Vietnam since 1995 with different concepts and understandings due to the lack of the legal regulations of dry port's operation and activities. However, the deficiency of legislation framework for the dry port operation had been diminished since the decision number 2223/QD-TTg in 2011 on "Official planning of dry port in Vietnam until 2020, vision to 2030" was enacted by Vietnamese Prime Minister in 2011. Then, decision number 47/2014/QĐ-TTg on "Regulation on management of dry port operations" provided the official definition of dry ports which has been used widely in Vietnam, specifically, dry port is transportation logistics node which is indivisible from transportation infrastructure, has a close collaboration with seaport, international airport, border checkpoint, and also acts as border gate for import and export goods (Transportation Development and Strategy Institute, 2016). Based on the latest announcement of Vietnam Ministry of Transport and relevant decisions, there are only 06 fully functioned and recognized dry ports in Vietnam which are ICD Phuc Loc (Ninh Binh), ICD Mong Cai (Quang Ninh), ICD Hai Linh (Phu Tho), ICD Tan Cang (Hai Phong), ICD Dinh Vu – Quang Binh (Hai Phong) and ICD Tan Cang – Nhon Trach (Dong Nai) ("Vietnamese Ministry of Transport has announced six dry ports in Vietnam", 2019). Before the time that the decision 47/2014/QĐ-TTg coming into force, most dry ports in Vietnam have been upgraded from Inland Clearance Depots and have been performing quite well basic functions of dry ports. Consequently, dry port in Vietnam can be referred to Inland Container Depot or Inland Clearance Depot. Regarding to this perspective, there are twenty-one dry ports in total situated mainly in the North (10 dry ports) and the South of Vietnam (11 dry ports). Following the report of Transportation Development and Strategy Institute (2016), in the north of Vietnam, only three out of ten dry ports are having connectivity to at least two modes of transport (ICD Hai Linh, ICD Lao Cai, and ICD MongCai). The average size of northern dry ports is small (below 10ha) and has a little potential for future expansion. The container throughput of these dry port is below 50.000 TEUs per year on average, only accounting for 0.2% of total cargo throughput via Hai Phong seaport (Transportation Development and Strategy Institute, 2016). Differentiated fro

[1]*Decision No:1201/QĐ-BGTVT on Approval for the Detail Development Plan of Dry ports in Vietnam until 2020, vision to 2030*

m the northern ICDs, dry ports in the south of Viet nam mostly close to seaports (Ho Chi Minh, Binh Duong, Dong Nai) with the average distance is fro m 20km to 70km. Southern dry ports have been per forming well their role as an extended arm of the s eaport, for instance, around 35% to 40% of exporte d and imported containerized cargoes have been don e the customs clearance procedures at dry ports (Tra nsportation Development and Strategy Institute, 201 6). In terms of intermodal transportation, dry ports i n the south of Vietnam have a huge advantage in t he inland waterway network and currently, inland w aterway transportation has accounted for 30% to 35% of total cargo movement. Responding to the demand of extending and developing the dry port network, Vietnam Ministry of Transport approved the Decisio n No.1201/QD-BGTVT dated June 6, 2018 on "Det ail plan for developing the dry port systems in Viet nam until 2020, vision to 2030". In terms of the nu mber of dry ports in Vietnam, in the next 5 years (2025) this figure will be almost tripled compared t o the current situation, especially, the central of Viet nam starts to implement dry ports in some main ec onomic corridors that is expected to enhance the bal ancing of logistics capability and ability in different regions of Vietnam. Nonetheless, not all of these dr y ports have not been constructed fully, some of th em still are in the master plan due to some huge c hallenges: land fund scarcity, backward railway syste m, undeveloped transportation infrastructure and fina ncial budget (Dang, 2019).

2.2 Study on Dry Port in Vietnam

Actually, the number of studies on dry ports in Vietnam is rare, and most of them currently are reports or proposals for the general implementation of dry ports in Vietnam released by United Nation (ESCAP – Economic and Social Commission for Asia and the Pacific) or by Vietnamese government agencies. Some academic research have been done in the narrower aspects, for instance, location of dry port or partnership model for dry port development. However, so far, there is no article which have examined either the competitiveness of dry port's in Vietnam or influencing determinants for dry port competitiveness.

Table 1: Key studies on dry port in Vietnam

Author [Year]	Article/Methodology	Major Findings
Pham and Lee, (2019)	Developing a Green Route Model for Dry Port Selection in Vietnam /Case Study	Implementing dry port which supports intermodal transportation through rail or inland waterway could reduce the gas emission during the whole route.
Nguyen and Notteboom (2017)	Public-Private partnership model selection for dry port development: an application to Vietnam/Multi-criteria analysis	Based on risk-benefit approach for different types of PPP models, the best solution for the collaboration between private and public sector is field concession
Nguyen and Notteboom (2016)	A multi-criteria approach to dry port location in developing economies with application to Vietnam/Multi-criteria analysis	The development of dry port in developing countries seems to be driven by production base inland where dry port act as a logistics node to facilitate cargo movement from hinterland to seaports and vice versa.

2.3 Research Model

With an aim for applying the AHP and IPA methodology, it is essential to select the criteria potentially influencing dry port competitiveness in Vietnam. Based on the comprehensive literature review, the cautious interview with professionals in the field in Vietnam, there are 15 selected sub-criteria divided into 5 main principal groups.

Transportation Connectivity plays a crucial role in dry port implementation and competitiveness. Indeed, a dry port is the next phase of seaports development system

according to the life cycle theory (Fatimazahra et al., 2016), of which, it performs similar functions as same as seaports but in the hinterland with diversified modes of transportation. In practical, road network, rail network and inland waterway network are the most common transportation methods which have been used at dry ports. Examining the significant factors for selecting the dry port location in developing economies, under the dry port users' perspective in Vietnam (including shippers, logistics providers, transport companies and freight forwarders), the accessibility to road, rail and water network are three out of eight criteria which have the significant influence on the logistics efficiency – the primary attractiveness to dry port users (Nguyen and Notteboom, 2016).

Geographical Distance, initially, the appearance of dry ports resulted from the demand to lower the transportation pressure on some seaports by gathering cargoes at the dry port before or after they are loaded or unloaded from shipping lines through the railway systems directly connected between dry ports and seaports (Woxenius et al., 2004). In case of outside-in dry ports, the close distance from dry port to the seaport is an essential feature to help reduce transportation cost and total transit time of the cargo (ESCAP, 2014). Nevertheless, in different regions, especially, in developing countries, the inside-out dry ports are more common due to the dependence on inland production base and the unimprovement of inland transportation infrastructure (Wilmsmeier et al., 2011). Therefore, the proximity of dry ports to seaports or to production bases (economic corridors and industrial zones) is considered as an attractive point to different targeted customers of the dry ports.

As for the Infrastructure, the greater the port infrastructure is, the higher competitiveness the port possesses (VanDyck and Ismael, 2010; Song and Yeo, 2004). Dry port is a solution to solve the congestion at the seaports, hence, size of dry ports (terminal size, container yard, warehouse) and facilities (handling and transshipment) must be capable to consolidate, handle, store or facilitate the definite volume of cargo transited from/to seaport or production base in hinterland (Song and Yeo, 2004).

In terms of Value-added Service, diversifying the value-added services offered by the dry port is a long-term goal for each dry port in the fierce competition due to its advantages on enhancing dry port attractiveness, increasing the demand and improving the profitability of dry port (Andersson and Roso, 2016). According to the interviews with managers of dry ports in Vietnam, there are three main value-added services that can differentiate the ability and capability of dry ports, namely, automated container inspection, cold chain management, and midstream operation.

Cost represents the financial expenses that customers have to bear when using the services at dry ports. Obviously, economic benefits in terms of service price are the significant factor for customers to decide whether or not to use the services at a dry port, or to carry cargo directly from seaports to hinterland destinations and vice versa (Song and Yeo, 2004). In the ideal condition, the involvement of intermodal transportation at dry ports is an attractiveness to customers thanks to the environmental benefits and the lower transportation cost compared to using only the road systems for carrying cargo (Nguyen and Notteboom, 2016). The authors also emphasize that the ease of doing business helps increase the competitiveness of dry port. Based on the interviews with many professionals in the fields as the same as dry port's managers in Vietnam, the cost for administrative procedures still accounts for a high portion of the total cost that enterprises have to pay when using the services at dry port. Therefore, the dry port which has better and more convenient administrative procedures, for example, customs clearance services, will have more advantages against other dry ports. The highest layer represents the goal of the study – the analysis of priorities for dry port competitiveness in the north and the south of Vietnam based on the AHP and IPA approach. The second layer is the main influencing determinants: Transportation Connectivity, Geographical Distance, Infrastructure, Value-added services and Cost. The sub-criteria are set in the third layer, where each group of three sub-factors are gathered corresponding to their main determinants. The last layer symbolizes the two alternatives which are observed and analyzed simultaneously with the sub-criteria to examine the importance degree of each factor in different regions.

The research model is based on wide range of previous literature and interview processes which provide justification on the choices of relevant variables in the research model (see Appendices).

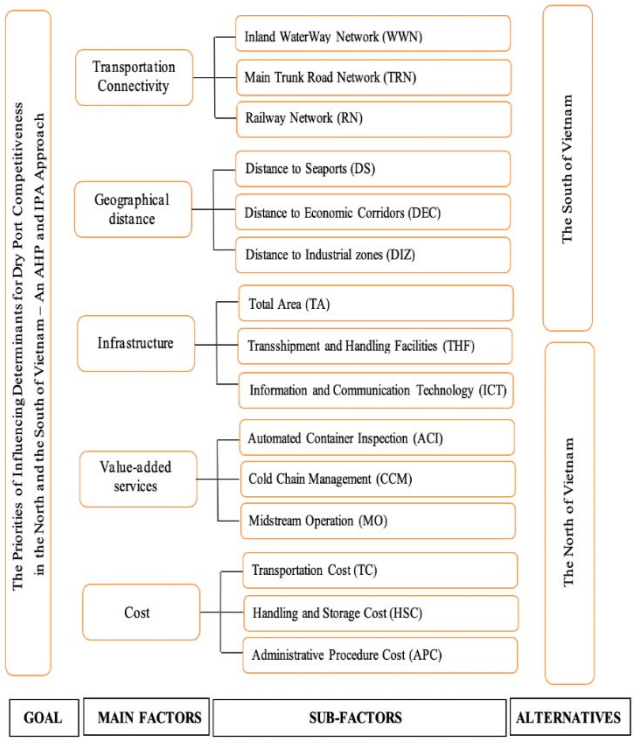


Figure 1: Research Model

Source: see appendices for references

3. Analysis on the Priorities of Influencing Determinants for Dry Port Competitiveness in the North and the South of Vietnam

3.1 Data Collection

Questionnaires were conducted to collect the data relating to the evaluation of experts and customers on the priorities of some specific factors affecting dry port competitiveness in Vietnam. During the data collection, 60 AHP surveys and 120 IPA surveys had been released, however, only 25 surveys out of 60 AHP surveys and 53 surveys out of 120 IPA surveys were qualified to conduct the analysis.

3.2 The AHP Analysis on the Priorities of Influencing Determinants for Dry Port Competitiveness in the North and the South of Vietnam

According to the result from analysis on the view of experts who participated in the questionnaire round, Cost is the most essential determinant for Vietnam dry port competitiveness, then it is followed by the Transportation Connectivity (0.222), Geographical Distance (0.178), Value-added services (0.169) and Infrastructure (0.151). The overall inconsistency (CR) is equal to 0.02 < 0.1, therefore, the consistency of the model is ensured (Table 2).

Table 2: The priorities of sub-factors for dry port competitiveness in the north and the south of Vietnam

Main Factors	The North of Vietnam	The South of Vietnam	Global weights	
	Priority level	*Priority level*	*Priority level*	*Rank*
Overall	*0.485*	*0.515*	-	
Main Trunk Road Network (TRN)	0.620	0.380	**0.120**	**1**
Transportation Cost (TC)	0.547	0.453	**0.106**	**2**
Handling Storage Cost (HSC)	0.493	0.507	**0.091**	**3**
Distance to Industrial Zones (DIZ)	0.408	0.592	**0.087**	**4**
Administrative Procedure Cost (APC)	0.682	0.318	**0.084**	**5**
Automated Container Inspection (ACI)	0.415	0.585	**0.075**	**6**
Inland Waterway Network (WWN)	0.238	0.762	**0.062**	**7**
Cold Chain Management (CCM)	0.411	0.589	**0.060**	**8**
Transshipment and Handling Facilities (THF)	0.391	0.609	**0.059**	**9**
Distance to Economic Corridors (DEC)	0.495	0.505	**0.051**	**10**
Information and Communication Technology (ICT)	0.406	0.594	**0.047**	**11**
Total Area (TA)	0.524	0.476	**0.045**	**12**
Distance to Seaport (DS)	0.404	0.596	**0.040**	**13**
Railway Network (RN)	0.659	0.341	**0.039**	**14**
Midstream Operation (MO)	0.298	0.702	**0.047**	**15**

Generally, the selected determinants seem to have more influence on the competitiveness of dry ports in the southern side (0.515) compared to the north of Vietnam (0.485). Geographical Distance, Infrastructure and Value-added Services are more prioritized in the southern dry ports regarding to dry port competitiveness, while, Transportation and Connectivity and Cost are evaluated to have the stronger influence on the competitiveness of northern dry port in Vietnam.

Table 3: The priorities of main factors for dry port competitiveness in the north and the south of Vietnam

Main Factors	The North of Vietnam	The South of Vietnam	Model	
	Priority level	*Priority level*	*Priority level*	*Rank*
Overall	*0.485*	*0.515*	-	
Cost	0.561	0.439	**0.280**	**1**
Transportation Connectivity	0.534	0.466	**0.222**	**2**
Geographical Distance	0.435	0.565	**0.178**	**3**
Value-added services	0.393	0.607	**0.169**	**4**
Infrastructure	0.440	0.560	**0.151**	**5**

In terms of the priorities of sub-criteria, the analysis result is illustrated in Table 3. Among 15 sub-factors, there are 12 determinants which are considered to have more relative importance for the competitiveness of dry ports in the south of Vietnam, compared to the northern dry ports (for detailed,Handling and Storage Cost, Distance to Industrial Zones, Container Automated Inspection, Inland Waterway Network,Cold Chain Management, Transshipment and Handling Facilities, Distance to Economic Corridors, Information and Communication Technology, Distance to Seaports, Midstream Operation). Main Trunk Road Network, Transportation Cost, Administrative Procedure

Cost, Total Area and Railway Network have the higher weight importance in the northern dry ports.

3.3 The IPA Analysis on the Importance and Performance of Factors for Dry Port Competitiveness

The IPA analysis is performed for all the chosen criteria and based on the evaluation of customers via 5-point Linkert scale. The mean value and the standardized value of each factor are calculated for different purposes.

Comparing the mean value between the importance level and the performance level of each factor in the northern dry ports and southern dry ports in Vietnam (Figure 2), it is obvious that the performance of fifteen factors examined in the northern dry ports and the southern dry ports in Vietnam is lower than its corresponding importance level.

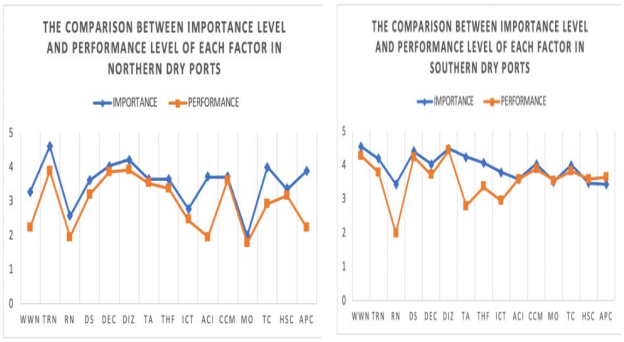


Figure 2: Importance - Performance Comparison

The gap between the importance and performance of some factors are still noticeable, for example, Inland Waterway Network, Rail Network, Automated Container Inspection, Transportation Cost and Cost for Administrative Procedures in the northern dry ports; Railway Network, Total Area, Transshipment and Handling Facilities, and Information and Communication Technology in the southern dry ports. Nonetheless, the average satisfaction of customers in the southern dry ports is relatively better than the customers' satisfaction in the dry ports in the north of Vietnam.

All the standardized values are arranged in different quadrants of an Importance – Performance matrix, where the horizontal axis represents the importance level, and the vertical axis symbolizes the performance (satisfaction) level. The intersection between importance axis and performance axis is set to the mean value (Figure 3 and Figure 4).

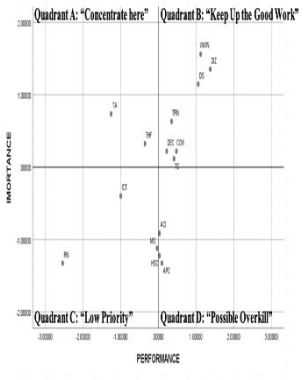


Figure 3: The IPA analysis for factors affecting Dry Port Competitiveness in the North of Vietnam

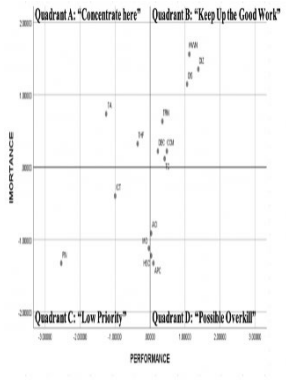


Figure 4: The IPA analysis for factors affecting Dry Port Competitiveness in the South of Vietnam

Table 4. Summarization of IPA analysis

Quadrant	Implications	Factors for dry port competitiveness	
		The North of Vietnam	The South of Vietnam
Quadrant A: Concentrate here	High importance, low performance. It reflects the dissatisfaction of customers; therefore, these factors need to be prioritized continuously.	ACI, APC, TC	TA, THF
Quadrant B: Keep up the Good work	High importance, high performance. The current level of performance should be maintained and continuously improved.	TRN, DIZ, DEC, CCM, TA, THF, DS	WWN, DIZ, DS, TRN, DEC, CCM, TC
Quadrant C: Low priority	Low importance, low performance. It is suggested that dry ports should not concentrate on development of these factor in short term.	WWN, ICT, RN, MO	ICT, RN, MO
Quadrant D: Possible Overkill	High performance, low importance.	HSC	ACI, HSC, APC

The majority of criteria are situated in the up-right corner and down-left corner in both the northern and the southern dry ports in Vietnam – the quadrant B and quadrant C. Most of criteria are evaluated as having the high-importance to the dry port competitiveness (ten factors in the northern dry ports and nine factors in the southern dry ports). In terms of performance, the southern dry ports have ten out of fifteen factors fallen into the high-performance areas, while there are only eight factors located in the same area in the northern dry ports (the right half of the matrix). In quadrant A – "Concentrate here", dry ports in the northern side should improve the performance of administrative procedure cost, transportation cost and automated container inspection service, while in the southern dry ports, the total area and transshipment-handling facilities at dry ports are the two most important criteria which need to be improved continuously. The summarization of IPA analysis is described in Table 4.

4. Discussion

The AHP and IPA approach use the same set of fifteen sub-criteria which are arranged into five main factors: Transportation Connectivity, Geographical Distance, Infrastructure, Value-added Service and Cost. These principal factors have been caught in many studies (Parola et al., 2017), that helps to create a solid foundation for the research. Simultaneously, the relevant sub-factors are selected based on the capability to illustrate the typical operating characteristics of the dry port in the north and the south of Vietnam through the several semi-structured interviews with experts and the cautious review on the related research which had been done in Vietnam.

From the AHP analysis, in terms of dry port competitiveness, Transportation Connectivity and Cost are more prioritized in the north, and the rest of the influencing determinants for dry port competitiveness are paid more attention in the south of Vietnam. This result emphasizes that, in general, the better price for services at dry ports, and the higher competitiveness. If a dry port aims at declining their price to gain more competitiveness in the market, it is extremely important to utilize the inherent advantages in the connectivity with different modes of transport to reduce the logistics cost, provide various value-added services which meet the demand of customers, and maximize operational effectiveness.

Main Trunk Road Network, Distance to Industrial Zones, Transshipment and Handling Facilities, Container Automated Inspection and Transportation Cost represent the most important sub-criteria with respect to the dry port competitiveness for each main factor. This result reflects the current development situation of the dry port in Vietnam, for specifically, the road systems still plays a significant role of the dry port connectivity, in other words, it describes the limitation of multimodal transport and the high cost for cargo transportation in Vietnam dry port; the development of dry port in Vietnam is driven by the demand to facilitate cargoes from production bases to ports, especially, from the industrial zones; the infrastructure in the dry port is poor and not fully equipped to perform the complex functions, therefore, many dry ports simply provide the storage service or transit place for cargoes ("ICD in Vietnam: Current Situation and Expectation", 2017).

In the north of Vietnam, the high importance intensity of Administrative Procedure Cost reflects the fact that

"general facilitation cost" in the northern dry port still accounts for a relatively high portion in the total cost, that would create a barrier to decrease the attractiveness of dry ports. Therefore, it would be the shortcomings if not mentioned to the importance of the collaboration and support from the government by enacting needed regulations to reduce the complexity and corruption generated from the execution of administrative procedures at dry ports.

Relating to the southern dry ports in Vietnam, in general, the selected criteria have more influence on the southern dry ports' competitiveness. The majority of dry ports in the south are situated nearby seaports and inland waterway network, therefore, the utilization of modal transportation is more convenient, and the cost for transportation is reduced significantly. Additionally, the relatively close distance from dry ports to industrial zones or manufacturing areas also helps to facilitate the movement of cargo more easily. Although it is expected that, in 2020, the southern economic corridors still make up for the highest portion (approximately 54%) of the total container throughput through the entire countries (TDSI, 2016), the severe competition between the southern dry ports specifically and dry ports in Vietnam in general is unavoidable due to the expansion of the current dry ports as the same as the new ones which will be implemented in Vietnam in the next ten years.

From the customer's perspective, in the northern dry ports, the IPA analysis points out the biggest barrier for the competitiveness of the northern dry ports is about Cost. Transportation Cost and Administrative Procedure Cost have high importance but low performance (quadrant A). This consequence possibly results from the lack of intermodal transport utilization and the deficiency of collaboration and support from the government to reduce the complexity and corruption generated during the administrative procedures at the northern dry ports. Due to the large volume of cargo throughput as well as the difficulties to expand the dry port area, on the southern side, Total Area and Transshipment – Handling Facilities are getting the relatively strict evaluation from customers and classified as having high importance but low performance.

Total Area, Transshipment-Handling Facilities, Main Trunk Road Connectivity, and Cold Chain Management are four factors that the northern dry ports should maintain and improve continuously. Meanwhile, other factors fall into the quadrant B of the southern dry ports are Inland Waterway Network, Main Trunk Road Connectivity, Cold Chain Management and Transportation Cost. In addition, Inland Waterway Network and Railway network belong to quadrant C– "Low priority" reflects the restriction in terms of using intermodal transportation at the northern dry ports. In contrast, the southern dry ports have utilized the multimodal transportation better when only the railway network is classified as a low priority for dry ports in the south, while Inland Waterway Network, Main Trunk Road Connectivity are in quadrant B.

Regarding the dry port's infrastructure, only Information and Communication is evaluated as a low priority in both groups of respondents. According to the interview with several respondents, despite the undesirability of the importance of ICT in performing the complex functions at dry ports in the long-term, the investment in ICT is capital-intensive investment, and moreover, it requires a better integration between the information systems of dry ports and customers. Therefore, in the short-term, this factor is rated low priority.

In fact, the midstream operation is only performed in the southern dry ports due to some typical geographical characteristics, therefore, it is understandable to classify it into quadrant C. The reason behind the ranking of this service in the southern dry ports is the restriction in terms of operation regulations. Currently, only ICD Phuoc Long got the admission to implement this service among 11 ICDs in the south of Vietnam. Hence, this service is not applicable for all customers, moreover, there are several risks possibly generated during the loading and unloading in midstream. The factors relating to cost account for higher importance in the northern dry ports than in the southern dry ports, however, the corresponding performances are relatively lower compared to the dry ports in the south of Vietnam.

5. Conclusions

Although the research results describe the priorities of factors with respect to dry port competitiveness in the north and the south of Vietnam through the AHP and IPA approach, the outcome has been constrained due to the limitation of time that leads to the modest sample size and

the incapability to analyze the data based on the identification of each group of respondents. Hence, there are several research opportunities that could be conducted in the future to validate or to expand the research scope and research objects of this exploratory study. Also, some of the variables might be correlated which can have a negative impact on the quality of AHP analysis of this study. For future research, it is important to distinguish the characteristics of each variable based on correlation analysis to avoid any possible statistical bias. Moreover, although cold chain management industry is growing very fast due to the widespread Covid19, the current study has dealt with only the static part of it in dry ports of Vietnam which can be expanded throughout the whole supply chain from static to dynamic flows of logistics in future research.

The present paper has a few policy implications. First, it is important for dry port's managers and operators to maintain the good performance of the current comparative advantages, for example, the geographical distance of dry port, and keep improving some factors which are high importance and low performance, for instance, administrative procedures, transportation cost). Second, for the public sector, in order to implement dry ports successfully, the cooperation and support of the public sector in the development process could not be ignored, especially, in terms of providing a proper and comprehensive development plan for not only dry port system but also the national transportation infrastructure. Besides, it is necessary to have the official regulations for operating administrative works at dry ports to ensure time and cost savings for participants involving in the dry port ecosystems.

Acknowledgements

This paper is a modified version of the master thesis of International Trade department of Chungnam National University and was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2021S1A5B8096365)

References

Andersson, D., and Roso, V. (2016). "Chapter 12: Developing Dry Ports through the use of Value-Added Services". Commercial Transport, Lecture Notes in Logisitics (pp.191-203). Switzerland, Springer.

ESCAP. (2014). "Development and Operation of Dry Ports of International Importance". Economic and Social Commission for Asia and the Pacific (p.

Fatimazahra, B., Fri, M., Mabrouki, C., and Semma, A. (2016). "Dry Port-Seaport System Development: Application of the Product Life Cycle Theory". Journal of Transportation and Logistics, Vol.1 No. 2, pp.116-128.

Nguyen, L. C., and Notteboom, T. (2017). "Public-private Partnership Model Selection for Dry Port Development: An Application to Vietnam". World Review of Intermodal Transportation Research, Vol.6 No.3

Nguyen, L., and Notteboom, T. (2016). "A Multi-Criteria Approach to Dry Port Location in Developing Economies with Application to Vietnam". The Asian Journal of Shipping and Logisitcs, Vol.32 No.1, pp.023-032.

Notteboom, T., and Yap, W. (2012). "Port Competition and Competitiveness". Blackwell Publishing Ltd.

Pham, H. T., and Lee, H. (2019). "Developing a Green Route Model for Dry Port Selection in Vietnam". The Asian Journal of Shipping and Logistics, Vol.35 No.2, pp.96-107.

Transportation Development and Strategy Institute. (2016). "Detail planning for the development of dry port in Vietnam until 2020, vision to 2030". Hanoi: Vietnam Maritime Administration.

VanDyck, G., and Ismael, H. (2015). "Multi-Criteria Evaluation of Port Competitiveness in West Africa Using Analytic Hierarchy Process (AHP)". American Journal of Industrial and Business Management, Vol.5, pp.432-446.

Wilmsmeier, G., Monios, K., and Lambert, B. (2011). "The Directional Development of Intermodal Freight Corridors in Relation to Inland Terminals". Journal of Transport Geography, Vol.19 No.6, pp.1379-1386.

Woxenius, J., Roso, V., and Lumsden, K. (2004). "The Dry port Concept - Connecting Seaports with their Hinterland by Rail". ICLSP. Dalian.

Yeo, G. T., Song, D. W., Dinwoodie, J., and Roe, M. (2010). "Weighting the Competitiveness Factor for Container Ports under conflicting interests". Journal of the Operational Research Society, Vol.61, pp.1249-1257.

Dang, L. V. (2019). "Finding the Optimal Order of Priority for Dry Port Construction : Case Study in the North of Vietnam (Doctoral dissertation)",「RISS」, Retrieved October 2, 2019, from HYPERLINK

"http://www.riss.kr/search/detail/DetailView.do?p_mat_type=be54d9b8bc7cdb09&control_no=603f0ccb33a6ffa1ffe0bdc3ef48d419"
http://www.riss.kr/search/detail/DetailView.do?p_mat_type=be54d9b8bc7cdb09&control_no=603f0ccb33a6ffa1ffe0bdc3ef48d419

"ICD in Vietnam: Current Situation and Expectation" (2017.09.26.), 「Vidameco」, Available at HYPERLINK "http://www.vimadeco.com.vn/quan-he-co-dong/bao-cao-tinh-hinh-cac-icd-tai-viet-nam-thuc-trang-va-trien-vong"
http://www.vimadeco.com.vn/quan-he-co-dong/bao-cao-tinh-hinh-cac-icd-tai-viet-nam-thuc-trang-va-trien-vong

Appendices

No	Sub-criteria	References
I	**Transportation Connectivity (TC)**	
1.1	Inland Waterway Network (WWN)	Yeo et al. (2010), Nguyen, LC. and Notteboom, Theo (2016), Pires da Cruz etal. (2013), Yeo et al. (2011), Huang et al. (2003), Lee et al. (2014), Teng et al. (2004), Wen Li (2010), Parola et al. (2017)
1.2	Main Trunk Road Network (TRN)	Lee (2004), Yeo et al. (2010), Nguyen, LC. and Notteboom, Theo (2016), Pires da Cruz et al. (2013), Yeo et al. (2011), Huang et al. (2003), Lee et al. (2014), Teng et al. (2004), Wen Li (2010), Parola et al. (2017).
1.3	Rail Network (RN)	Lee (2004), Yeo et al. (2010), Nguyen, LC. and Notteboom, Theo (2016), Pires da Cruz et al. (2013), Song et al. (2004), Yeo et al. (2011), Huang et al. (2003), Lee et al. (2014), Teng et al. (2004), Wen Li (2010), Parola et al. (2017).
II	**Geographical Distance (GD)**	
2.1	Distance to seaport (DS)	Lee (2004), Yeo et al. (2010), VanDyck and Ismael (2015), Pires da Cruz et al. (2013), Song et al. (2004), Lee et al. (2014), Teng et al. (2004), Parola etal. (2017).
2.2	Distance to economic corridors (DEC)	Yeo et al. (2010), Nguyen, LC. and Notteboom, Theo (2016), Yeo et al. (2006), Pires da Cruz et al. (2013), Song et al. (2004), Lee et al. (2014), Tenget al. (2004), Parola et al. (2017).
2.3	Distance to industrial zones (DIZ)	Yeo et al. (2010), Nguyen, LC. and Notteboom, Theo (2016), Yeo et al. (2006), Pires da Cruz et al. (2013), Song et al. (2004), Lee et al. (2014), Teng et al. (2004), Parola et al. (2017).
III	**Infrastructure (I)**	
3.1	Total Area (TA)	Lee (2004), Xiaoqing (2009), Song et al. (2004), Lee et al. (2014), Yuen et al.(2012), Parola et al. (2017).
3.2	Transshipment and HandlingFacilities (THF)	VanDyck and Ismael (2015), Pires da Cruz et al. (2013), Xiaoqing (2009), Song et al. (2004), Huang et al. (2003), Lee et al. (2014), Wen Li (2010), Parola et al. (2017).
3.3	Information and Communication Technology (ICT)	VanDyck and Ismael (2015), Yeo et al. (2006), Huang et al. (2003), Teng et al. (2004), Yuen et al. (2012), Parola et al. (2017).
IV	**Value-added Services (VS)**	
4.1	Automated Container Inspection (ACI)	Yeo et al. (2006), Lee et al. (2014), Interview
4.2	Cold Chain Management (CCM)	Yeo et al. (2006), Interview
4.3	Midstream Operation (MO)	Interview, ("The Introduction of ICD Phuoc Long", 2013)
V	**Cost (C)**	
5.1	Transportation Cost (TC)	Yeo et al. (2010), Nguyen, LC. and Notteboom, Theo (2016), Yeo et al (2011), Huang et al. (2003), Lee et al. (2014), Wen Li (2010), Yuen et al. (2012).
5.2	Handling and Storage Cost (HSC)	Yeo et al. (2010), VanDyck and Ismael (2015), Nguyen, LC. and Notteboom, Theo (2016), Gunning (2000), Yeo et al. (2006), Pires da Cruz et al. (2013), Xiaoqing (2009), Yeo et al. (2011), Lee et al. (2014), Wen Li (2010).
5.3	Administrative Procedure Cost (APC)	Nguyen, LC. and Notteboom, Theo (2016), Yuen et al. (2012).

Received 01 December 2021
Revised 13 December 2021
Accepted 15 December 2021