Empirical Analysis of Selection Criteria of Container Ports in the Bay of Bengal

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벵갈만 지역의 컨테이너항만 선택 기준에 관한 연구

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Abstract

The purpose of this study is to provide a comparative evaluation of container port criteria at four major container ports in the Bay of Bengal, including Colombo Port in Sri Lanka, Chennai Port in India, Chittagong Port in Bangladesh and Yangon Port in Myanmar. Important container port selection criteria are identified and comparisons among container ports are made using previous studies, personal interviews and questionnaires, completed by top shipping companies, freight forwarders, logistics service providers, and experts in Myanmar.

The AHP method is used to verify the research model and hypothesis. This study identified five main criteria and eleven sub-criteria when choosing potential regional hub ports among the four ports in the Bay of Bengal.

The main findings from the five main criteria suggest that port efficiency is the highest priority criteria, and the second priority is port costs. The criteria of geographical location and available port facilities are the third and fourth most important, respectively, and the last priority is port's hinterland.

Regarding the relative competition among these ports, Colombo Port obtained the highest priority among the four influential factors except for port hinterland.

This study has certain limitations that will require future research. First, the sample group for the population size is relatively small. Second, interviewees had limited experience answering questionnaires using this methodology and a limited amount of time was available for respondents for the interviews.

Key words: Port Selection Criteria, Analytical Hierarchy Process(AHP), Bay of Bengal

Ⅰ. INTRODUCTION

Ports play multiple roles in the shipping and maritime industry. They represent a link between sea transport and land transport. Ports are links that connect the sea and the continental hinterland, representing a continuous flow of goods that transcend borders. Ports are an integral part of base production, logistics, trading, and the transfer of information.

These days, the container port industry is highly competitive. Shipping lines and agents must select criteria such as minimum waiting time, tariff rates, differences in turnaround time, ease of access, safety of cargo, and good quality service to deal with the container ships and cargo that offer them a competitive advantage.

A modern and efficient regional container port is essential for the economic development of countries(Irwin and Tervio, 2002; Hu and Zhu, 2009). Regional container ports are the gateway for facilitating trade in regions. They play a vital role in economic development by connecting the hinterland within the region through inland transport such as rail/road and waterways, transporting maritime goods, by bringing in foreign currency, through direct and indirect employment opportunities they provide, and through the development of internal infrastructure facilities and various transportation modes in the region. This is a global phenomenon. In Northeast Asia, Japanese, Korean and Chinese ports compete for cargo container transport of China's northeastern region. Similarly, Singapore and Hong Kong are the main hub ports of Southeast Asia. This paper attempts to advance the strategic development of container ports around the Bay of Bengal can develop to handle the majority of trade around the bay.

However, there are hindrances to the development of container ports in the Bay of Bengal. There are a number of key attributes that regional hub terminals must possess in order to be successful: including a considerable volume of captive traffic, a location central to main shipping routes and feeder ports, sufficient water depth and harbor space to accommodate the very large container ships, appropriate infrastructure and superstructure, including good intermodal linkages and appropriate container lift equipment, sufficient capacity to meet peak demand, high productivity, competitive rates and tariffs, a reliable and trouble-free labor force, and good security(Ircha, 2006).

The objectives of this paper are to chart the performance of ports in the Bay of Bengal and their importance in their respective countries, understand the future potential of regional container hub ports in the Bay of Bengal region with current capacity, identify criteria affecting shipping companies' port choices based on a survey that sampled shipping companies and port users, determine the port performance criteria that shipping companies and other port users consider important when selecting a port and how these criteria are prioritized according to their importance, and determine the potential regional hub ports for shipping lines and port users' preferences through major ports around the Bay of Bengal.

Ⅱ. Research Background

The Bay of Bengal is bordered on the east by Myanmar, on the west by India and Sri Lanka, and by Bangladesh to the north. Important ports in the region include Cuddlier, Chennai, Kakinada, Machilipatnam, Vishakapatnam, Paradip, Kolkata, Chittagong, Colombo and Yangon. Among them, this paper analyzes the four largest ports in the Bay of Bengal: Chennai Port in India, Chittagong Port in Bangladesh, Yangon Port in Myanmar, and Colombo Port in Sri Lanka. These ports were chosen because they represent the main ports in the Bay of Bengal.

In the northwest corner of the Bay of Bengal, Chittagong Port sits in a densely populated region and is a major port in Bangladesh. Chennai Port, on the other hand, has the strategic advantage of having the entirety of south India as its hinterland and is emerging as a hub port on the east coast of the country. The advantages of their respective locations allow these ports to handle a variety of cargo comprising of containers, liquid and break bulk cargo. Yangon Port is the only international gateway port of Myanmar, although it is river port. It is accessible to ships of up to 167 meters in length, and a maximum draft of around 9 meters during high tides in spring. Despite Colombo Port not being considered a major port around the Bay of Bengal, it is central to the bay and serves as an important terminal in Asia due to it strategic location in the Indian Ocean. Colombo port has developed into one of the busiest in the world and is one

of the benchmarks for of the port development around the Bay of Bengal (Morgan, Plummer & Wignaraja, 2015).

Figure 1. is the decision-making hierarchy for regional hub port selection. The methodology applied in this research is Analytic Hierarchy Process (AHP). AHP is used to deconstruct the decision-making problem and rank it into a hierarchy. The decision will be made based on the selected important criteria affecting the port selection decision, selecting the one with the highest score as a potential regional hub port in the Bay of Bengal.
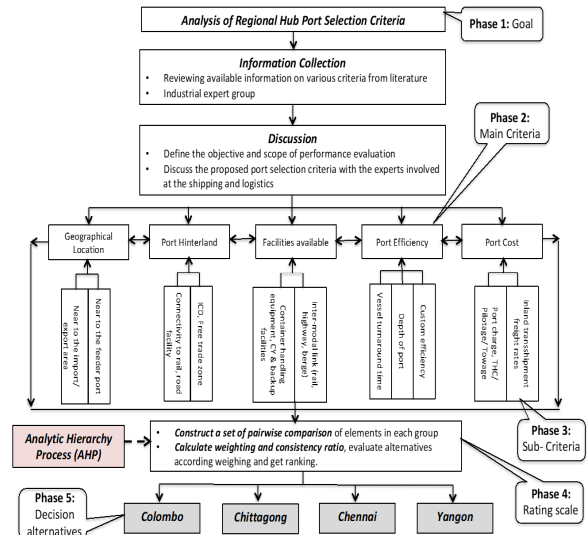

Figure 1. Decision-making Hierarchy

Ⅲ. THEORETICAL BACKGROUND

Nowadays, the container port industry is very competitive, with shipping lines and agents using

criteria such as low tariffs, safety, ease of access, minimum turnaround, waiting dwell, and administration times in dealing with the processing of their container ships and cargoes to select a port (Nooramin and Kiani, 2009). Table 1 highlights criteria previous studies have used for regional port selection.

Tai and Hwang(2005) have identified factors affecting hub port selection by shipping lines. They used the Gray Decision Model to rank the relative competitiveness of major ports, including Shanghai Kaohsiung, Yantian and Hong Kong, to analyze the performance factors of hub port selection from the viewpoint of container shipping liners. The authors suggest that the most important factors are "handling efficiency" and draft of harbor" as internal factors in port selection, "cargo source of hinterland" and frequency of routes" in the external factors of port selection and "saving in operating cost" in operation factors in port selection. In addition, Sayareh and Alizmini(2014) have broken the criteria down into two main categories; physical and servicing sectors. They completed an extensive review of port selection decision-making attributes using TOPSIS and AHP. Their findings suggest that working time, stevedoring rate, safety, port entrance, sufficiency of draft, capacity of port facilities, operating costs, number of berths, ship chandelling, and international policies are the most critical factors.

Chou(2009) also investigated the selection of container transshipment hub ports using the fuzzy multiple criteria decision-making (FMCDM) model. This method was tested using the ports of Hong Kong, Kaohsiung and Shanghai in Southeastern Asia. They found that transshipment costs, followed by hinterland economy, port efficiency, port location and physical conditions of the port are the most critical factors involved in transshipment port selection. In addition, Ha(2003) presents the comparative evaluation of service quality factors at 15 major container ports such as Singapore, Hong Kong, Kaohsiung, Kobe, Osaka, Gwangyang, Shanghai, and Busan in the Asian region, Rotterdam, Hamburg, Felixstowe, and Valencia in Europe, and Long Beach, Seattle, and New York in America. He applied Variance Analysis (Service Quality Factors), ANOVA and Duncan Test Analysis. His survey findings indicate that Singapore is the top level in all service sections, followed by Long Beach, Hong Kong, New York, Seattle and Rotterdam, while Busan, Kwagyang and Shanghai rank lowest in the respondents' opinions.

Wiegmans, Hoest and Notteboom(2008) focused on this research question: on what basis do deep-sea container operators select container ports (strategy) and container terminals (financial reasons) in the Hamburg-Le Havre range over others? To answer this research question, he has addressed three dimensions in detail: buying decision characteristics, port choice strategy and terminal selection. He has proposed the importance of different factors in affecting port choice from a carrier's perspective; namely, availability of hinterland connections, reasonable traffic and the immediacy of consumers (a large hinterland). Furthermore, he revealed that terminal selection criteria mainly depend on handling speed, handling costs, reli-

ability and hinterland connections.

Chang, Lee, & Tongzon (2008) have identified the six factors affecting shipping companies' port choice. Based on a survey of shipping companies, local cargo volume, terminal handling charges, berth availability, port location, transshipment volume and feeder network are the important criteria. This paper utilized exploratory factors and confirmatory factor analysis to identify five port choice categories including; advancement/ convenience of port, physical/operational ability of port, operational condition of shipping lines, marketability and port charges.

A comparison between the main trunk and feeder service providers indicated that the former face more intense than the ladder. Moreover, he pointed out that the main haul shipping liners are more sensitive to port cost factors.

Other studies were also focused on researching the influences of port and container terminal characteristics on terminal performance. Caldeirinha and Felicio(2009) have analyzed the sample composed of 151 managers valid responses from 12 Portuguese and Spanish container terminals. They have separated the port and terminal characteristics into six categories; port location, port specialization, inland accessibility, logistics oriented management, maritime accessibility and quay equipment.

The findings reveal that the main criterion that supports the customers' satisfaction is terminal logistics oriented management, followed by inland accessibility and maritime accessibility. Quay equipment is the most important characteristic that supports activity and efficiency.

It is clear from the literature survey that most studies have focused on a broad range of factors on regional or national cases. This paper expands on the existing literature by investigating further shipping lines and port users' port choice behavior in the Bay of Bengal to see if there is any difference in their port choice.

IV. EMPIRICAL ANALYSIS AND RESEARCH FINDINGS

A pilot study was conducted to identify port performance criteria through a literature review and through discussion with experts in the Myanmar logistics sector. Table 1. illustrates the criteria for hub port selection given by experts in the logistics field.

Table 1. Pilot Study of Identification of Criteria

Main Criteria	Sub-criteria	Remark
Geographical Location	• Near to import/export area • Location in transshipment center • Near to the feeder point	x o o
Port Hinterland	• Volume of import/export containers • Connectivity of rail, road • ICD, Free Trade Zone	x o o
Facilities Available	• Vessel traffic system • Container handling equipment • Inter-modal link	x o o
Port Efficiency	• Vessel turnaround time • Depth of port • Container yard efficiency • Custom efficiency	o o x o
Port Cost	• Port charge, THC/Pilotage • Inland transshipment freight rates • Port reputation	o o x

Note: O=strongly recommend, X=not recommended
Source: Compiled by Author.

Thus, a total of five criteria and eleven sub-criteria were created for the maximization of the priority of port performance elements in choosing a container port. Figure 2. reveals the decision tree of regional hub container port selection criteria, which is organized according to the results of a pilot survey of experts from shipping companies and related industries.
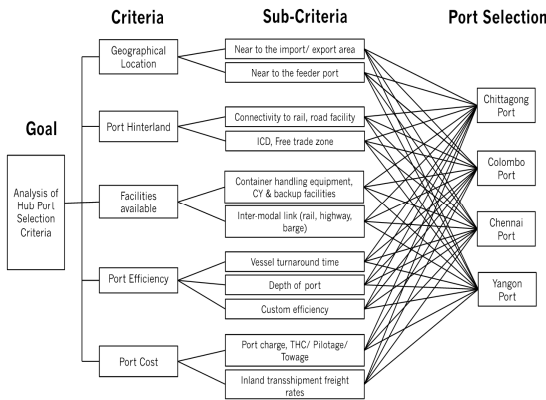

Figure 2. Decision Tree of Criteria on Port Selection

In order to compute the weights for the different criteria, the AHP starts creating a pairwise comparison matrix A. The matrix A is a m×m real matrix, where m is the number of evaluation criteria considered.

$$a_{jk} \cdot a_{kj} = 1.$$

Saaty and Vargas(1994) stated that Analytic Hierarchy Process (AHP) is a theory of measurement through pairwise comparisons and relies on the judgments of experts to derive priority scales. It is these scales that measure intangibles in relative terms.

Table 2. AHP Ranking Scale for Criteria

Value of a_{jk}	Definition	Explanation
1	Equal importance	j and k are equally important
3	Moderate importance	j is slightly more important
5	Strong importance	j is more important than k
7	Very strong	j is strongly more important than k
9	Extreme importance	j is absolutely more important than k

The comparisons are made using a scale of absolute judgments that represents, how much more, one element dominates another with respect to a given attribute. Table 3, where it is assumed that the jth criterion is equally or more important than kth criterion. It exhibits the nine-point fundamental evaluation scale that was used for the pairwise comparisons. The scaling is for qualitative data such as preference, ranking and subjective opinions, it is suggested to use scale 1 to 9. Results of the comparison (for each factors pair) were described in term of integer values from 1(equal importance) to 9 (extreme importance) where higher number means the chosen factor is considered more important in greater degree than other factor being compared with.

Once the matrix A is built, it is possible to derive from A the normalized pairwise comparison matrix A_{norm} by making equal to 1 the sum of the entries on each column, i.e. each entry $\bar{a}_{jk}$ of the matrix A_{norm} is computed as:

$$\bar{a}_{jk} = \frac{a_{jk}}{\sum_{l=1}^{m} a_{jk}}$$

According to Saaty, judgments of experts and professionals are normally arranged in a matrix often called the Matrix of Pairwise Comparison (MPC). To simplify the analysis of a MADM problem through an AHP, judgment of experts are reflected in an MPC, wherein a decision-maker specifies a judgment by inserting the entry aij(aij⟩0) indicating how much more important trait i is than trait j.

Finally, the criteria weight vector w (that is an m-dimensional column vector) is built by averaging the entries on each row of A_{norm} i.e.

$$w_j = \frac{\sum_{l=1}^{m} \bar{a}_{jl}}{m}$$

Tomar & Borad(2012) stated that after completing comparison of 5*5 matrix, the next step is to normalize the matrix. Considering the 5*5 elements to be compared, $C_1...C_5$ and denote the relative 'weight' (or priority or significance). Such a matrix is said to be a reciprocal matrix.

λ is calculated by averaging the value of the Consistency Vector:

$$\lambda = \sum_{i=1}^{n} Cv_{ij} \implies CI = \frac{\lambda_{max} - n}{n - 1}$$

CR: Consistency Ratio = CI/ RI
Where: CI = Consistency Ratio
      n = Number of criteria

The final step is to calculate the Consistency Ratio(CR) for this set of judgments using the CI for the corresponding value from large samples of matrices of purely random judgments(RI) using the Table 6, as CR=CI / RI. That needs to be assessed against judgments made completely at random and Saaty has calculated large samples of random matrices of increasing order and the Consistency Indices of those matrices. A true Consistency Ratio (CR) is calculated by dividing the Consistency Index (CI) for the set of judgments by the Index for the corresponding random matrix(Tomar & Borad, 2012).

Another important factor to consider in AHP is consistency. According to Saaty(1988), "the value of the consistency ratio should be 10 percent or less. If it is more than 10 percent, the judgments may be somewhat random and should perhaps be revised". AHP is able to discover which judgments, one by one, are the most inconsistent, in sequential order. AHP also suggests the value that best improves inconsistency. The decision maker can then use this criterion to refine the information.

Saaty suggests that if that ratio exceeds 0.1 there may be too much inconsistency in the judgment for it to be reliable. In practice, CRs of more than 0.1 occasionally have to be accepted. If the value of the CR is smaller or equal to 0.1, inconsistency is considered acceptable; otherwise there is a need to revise the subjective judgment. A CR of 0 means that the judgments are perfectly consistent.

In all 34 questionnaire survey forms from August to September 2017 were circulated among the top shipping lines in Myanmar to freight forwarders, port operators, experts and other port users. Of the 34 survey forms, 22 were returned

out of which 8 were not completed and were thus discarded. The remaining 22 questionnaires were analyzed using the AHP model.

As the research focuses on strategic issues, people holding high positions in their organizations were chosen. The 22 survey participants were CEOs or their equivalent, senior managers, and port masters or business development manager or equivalent ranks.

According to the responses of participants by job title. Of 8 interview participants of Chief Executive Officer(CEO) or equivalent professional level: 3 each were industry experts or from shipping companies, and two were from freight forwarding companies. Of 11 interview participants of General Manager or equivalent professional level: 9 were from shipping companies, 1 each from a freight forwarding company and an importing company. Of 3 interview participants of Port Manager/Business Development Manager or equivalent, one interview participant was an industry expert and 2 were from shipping companies.

The responses of the participants by years of work experience shows that 20 (91%) of the interview participants were CEOs or equivalent, General Manager or equivalent and Port Master/Business Development Manager or equivalent with 5 years or more working experience with high level rank in the shipping and logistics industry. Two(9%) interview participants of freight forwarding companies have at least 3 years working experience in the industry.

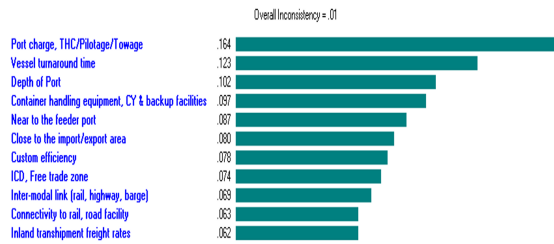Based on the response rate by type of industries/organizations. In the pie chart, 14(64%) participants were from top shipping companies such as Cosco shipping line, Evergreen line, TS line, Hyundai Merchant Marine, World Straits Maritime Sdn Bhd, First Maritime Pvt Ltd, BSV Container Line Pvt Ltd, Wallenius Wilhelmsen Logistics, Sinokor Merchant Marine, Atlantic Container Line(ACL), Pacific International Lines (PIL), American President Line(APL), CMA CGM and other shipping lines. Four(18%) were from logistics professions such as Myanmar International Freights Forwarders' Association (MIFFA), the Ministry of Transport and Communication, the Shipping Agency Department (SAD) and Ever Flow River(EFR). Three(14%) were from Freight Forwarding companies and one(4.5%) was from an import company.

The analysis results of the five main criteria and eleven sub-criteria for decision-making hierarchy are shown in Table 3 From the weight and priority vector figure it can be seen that port efficiency has obtained the highest priority criteria with a priority vector of 0.303. The second priority belongs to port cost, which has gained a priority vector of 0.226. Criteria of geographical location and facilities availability are the third and fourth most important by a priority vector of 0.167 and 0.166, respectively. The priority ratio of port hinterland criteria is 0.137.

The priority vectors for the decision hierarchy among the 11 sub-criteria are shown in Figure 3. and Table 3. Based on the priorities, the most important criteria affecting all respondents' port selection decisions in the Bay of Bengal is port charge accounting for 0.164 of priority vector.

Vessel turnaround and depth of port are from the same criterion port efficiency which are the second and third most important criteria by priority vector of 0.123 and 0.102, respectively. Location criteria of Near to the feeder port and Close to the import/export area account for 0.097 and 0.087, respectively as a fifth and sixth priority level.

Figure 3. Synthesis with respect to Sub-criteria

rail, road facility are far less important criteria in ranking, account for 0.069 and 0.063, respectively.

The results of a comparison analysis of the alternative container ports on each main criterion are given below. The alternative container ports include Chittagong Port, Colombo Port, Chennai Port and Yangon Port. The factor of Geographical Location includes Close to the import/export area and Near to the feeder port.

Figure 4. illustrates that Colombo records the best strategic geographical location among the compared ports with a priority vector of 0.425 and Chittagong Port is the lowest location priority level with 0.094. Chennai Port and Yangon Port are middle-ranked ports on the list, accounting for scores of 0.289 and 0.192, respectively.

Table 3. Priority of Container Port Selection

Main Criteria	Sub Criteria	Weight		Priority	CR
Geographical Location	Close to the import /export area	0.080	0.167	3	
	Near to the feeder service	0.087			
Port Hinterland	Connectivity to rail, road facility	0.063	0.137	5	
	ICD, Free Trade Zone	0.074			
Facilities Available	Container handling equipment, CY & backup facilities	0.097	0.166	4	0.1
	Intermodal link(rail, highway, barge)	0.069			
Port Efficiency	Vessel turnaround time	0.123	0.303	1	
	Depth of port	0.102			
	Custom efficiency	0.078			
Port Cost	Port charge, THC/pilotage/towage	0.164	0.226	2	
	Inland transshipment freight rates	0.062			

Custom efficiency and ICD, Free trade zone are less of a priority of port performance criteria selection, accounting for 0.078 and 0.074, respectively. Inter-modal link and Connectivity to

Figure 4. Synthesis with respect to Geographical Location

Figure 5. shows comparative results from the port hinterland of alternative container ports. Port Hinterland includes connectivity to rail, road facilities and ICD, Free Trade Zones. Chennai Port is perceived as having the most favorable hinterland connectivity among the comparative ports. The range between Chennai and Colombo is rather small with the priority vector of 0.348 and 0.319 but, notably, Chittagong port is not highly ranked in this category by 0.113. Yangon port has a potential hinterland network on the list accounting for 0.220.

Overall Inconsistency = .00

Channai	.348
Colombo	.319
Yangon Port	.220
Chittagong	.113

Figure 5. Synthesis with respect to Port Hinterland

A comparative analysis of port facilities' availability factors included Container handling equipment, CY & backup facilities, and inter-modal link (rail, highway, barge). Figure 6. illustrates perceptions of port facility availability and some of the tangible port infrastructure features. Colombo port is a highly developed container port. The range between Colombo port and the other ports are rather big in this category.

Overall Inconsistency = .02

|	
Colombo	.479
Channai	.270
Yangon Port	.161
Chittagong	.090

Figure 6. Synthesis with respect to Facilities Available

Chennai Port ranks second by 0.270 and Yangon Port by 0.161. Chittagong port ranks as having the least favorable port infrastructure and facilities feature on the list.

The results of a comparative analysis of the port efficiency of major container ports are given in Figure 7. These include vessel turnaround time, depth of port and custom efficiency. Colombo scores the highest, 0.463, the range of Colombo and Chennai port is rather big on the list. Chennai port ranks 0.266, followed by Yangon port, 0.157. Chittagong lags behind in this category with a score of 0.114.

Overall Inconsistency = .02

|	
Colombo	.463
Channai	.266
Yangon Port	.157
Chittagong	.114
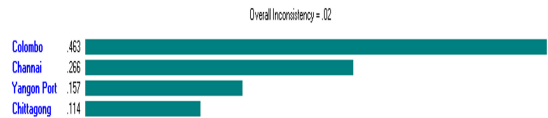
Figure 7. Synthesis with respect to Port Efficiency

Figure 8. shows comparative results from cost analyses of major container ports.

These costs include Port charge, THC/Pilotage/Towage and Inland transshipment freight rates.

Colombo Port has the highest service level in terms of cost efficiency accounting for 0.394. Chennai Port is ranked second with 0.298. The range between Yangon Port (0.158) and Chittagong Port (0.150) is rather small in this factor.

Overall Inconsistency = .00

Colombo	.394
Channai	.298
Yangon Port	.158
Chittagong	.150
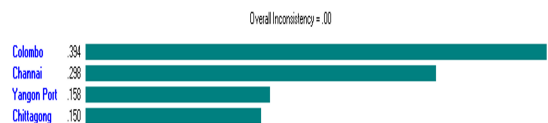
Figure 8. Synthesis with respect to Port Cost

In overall comparative results of port performance factors among container ports, Colombo ranks the highest in terms of most performance indicators such as favorable location, port infrastructure and facilities availability, port efficiency and port cost, while Chennai ranks second in these criteria. On the other hand, Chennai ranks well as having good hinterland connectivity among the competitive ports but Colombo is perceived as having lower hinterland connectivity than Chennai Port. Yangon Port appears to rank in the middle in all categories includes, geographical location, port hinterland, port facilities, port efficiency and cost of port. Chittagong Port was ranked the lowest in five performance criteria.

V. CONCLUSION

This thesis is an empirical analysis investigating the comparative evaluation of container port selection factors at 4 major ports in the Bay of Bengal. The study required an extensive analysis of the key literature in the field of port selection criteria, as well as a review of studies on the role of ports in each criterion.

This concluding chapter summarizes the research findings from a review of the literature and the empirical analysis, discusses the comparison research findings of this paper and previous papers and presents implications and recommendations of this study. The limitations of the research are discussed and further research directions are recommended.

The AHP analysis has shown that Colombo Port has obtained the highest rank in four influential factors for regional hub port choice. These factors include being situated in favorable location, having highly developed tangible port infrastructure and facilities, being a highly efficient port, and having high service levels compared to port charges. The second highest rank is given to Chennai, which had the highest marks in hinterland connectivity and the second highest rank in the four factors. Yangon Port is ranked third in all criteria. Chittagong Port was ranked lowest of the four ports in all measured influential elements.

The Port of Colombo is now the major container transshipment hub in the Bay of Bengal region. Although the Port of Colombo has a high container handling efficiency with effective port service quality, and a large volume of containers, the respondents did not choose the Port of Colombo as a favorable port hinterland connectivity port from/to South Asia and Southeast Asia because Sri Lanka is an island country in South Asia.

Chennai Port, on the other hand, is perceived as an efficient hinterland connectivity port among other competitive ports in the region. This is due to the fact that Chennai Port is well connected to other major cities through national highways and railway networks. It is connected with Kolkata through National Highway (NH) 5, to Mumbai through NH 4 and to Kanyakumari through NH 45. Chennai Port is the most cost-effective port in the region, with well-established

infrastructure facilities, and rail/road/sea connectivity.

Yangon Port and Chittagong Port took a third and fourth rank in all factors. Yangon Port and Chittagong Port are feeder ports with no direct calls from any of the top 20 international shipping lines to ports in the Bay of Bengal.

These shipping lines have slot charters that share common feeder operators. This decreases competition for one element of the containers' transit, which increases costs.

In order to compare with other research findings, Tai and Hwang (2005) investigated the influential factors of selecting transshipment hub ports by shipping lines. The research findings suggest that the most important factors are handling efficiency and draft of harbor that belong to the internal factors of ports, cargo source of hinterland and frequency of routes that belong to the external factors of ports, and the saving in operating cost for shipping lines.

Ha (2003) compared the service quality factors at 15 major container ports in Asia region, Europe and America. The findings suggest that Singapore is the top level in all service sections, followed by Long Beach, Hong Kong, New York, Seattle and Rotterdam while Busan, Kwagyang and Shanghai rank lowest in the respondents' opinions.

The most important criteria from carrier's perspective by Wiegmans, Hoest and Notteboom (2008) availability of hinterland connections, reasonable tariffs and immediacy of consumers (large hinterland). In addition to these criteria, shipping lines attach great value to often neglected factors such as feeder connectivity, environmental issues and the total portfolio of the port. Terminal selection criteria mainly depend on handling speed, handling costs, reliability and hinterland connections.

This paper provides a decision-making process for selecting the most appropriate regional container port (among four major ports studied) in the Bay of Bengal. The findings in this research have several implications for port performance management.

These findings are significant because in an environment where port competitiveness continues to increase, it is essential to know the key factors that come into the decision-making process of major port users and shipping companies. The results of this study provide empirical evidence that port efficiency is the most influential factor in port selection for shipping companies and port users. Therefore, it is necessary for port operators and policy makers to prioritize the improvement of their overall level of efficiency relative to other factors. This factor more than others is necessary to attract more port users to use their ports.

Chittagong Port and Yangon Port are smaller than the Port of Penang in Malaysia but have a larger range of services. One of the most significant factors seems to be location. Ports in the Bay of Bengal tend to see smaller ships than at other ports in ASEAN, with sizes rarely exceeding 3,000 TEU in the Bay of Bengal, compared to the 6,500-12,000 TEU ships that call on com-

parably sized ASEAN ports. This tends to increase costs for containers handled at ports in the Bay of Bengal.

Most trade around the Bay of Bengal is from the transfer of containers from smaller to larger container ships at hub ports such as Colombo, Port Klang and Singapore.

Improvement in access to the international container trade and a reduction in the cost of container transport will encourage international trade and intra regional trade in South and Southeast Asia. The development of main container lines calling on ports around the Bay of Bengal will help avoid the transshipment of containers at hubs and encourage greater access to the international container trade.

Currently all containers from the ports of Yangon and Chittagong are transshipped and at Chennai, that figure is at least 70%, mainly to Colombo. Transshipment of containers increases the overall cost by incurring additional costs. Except for at the Port of Chennai, none of the top 20 international shipping companies directly call on ports in the Bay of Bengal. They instead employ slot charters through common feeder operators. The result is a large reduction in the competition of one of the main elements of container movement, which pushes up transit costs. Other studies found that port charges relative to other factors are insignificant to port selection. The global trend among shipping liners seems to be the placement of greater emphasis the quality of service factors(Wignall, D. & M., 2014).

Myanmar is recognized as a potential land

bridge connecting South Asia and Southeast Asia in the future. Integration of existing infrastructure, including the ASEAN highway network, railways, and regional GMS economic corridors with the development of deep-sea ports will help Myanmar to connect with transport routes and access the international market. The Belt and Road initiative is a Chinese transport and communications infrastructure investment strategy that will link South and Southeast Asia, the Middle East, Eastern and Western Europe and will provide access to previously closed off hinterlands. Trade can move from South China Sea to the Bay of Bengal, skipping the Straits of Malacca, moving along the Asian Highway, Greater Mekong Subregions(GMS) economic corridor and OBOR's economic corridor routes, which will connect China with South Asia and Southeast Asia. The Belt and Road Initiative project will create huge opportunities for the development of port infrastructures and facilities. There will be large investments in upgrading current port facilities to in order to accept third and fourth generation container vessels, and in developing better deep-sea ports in the area like Kyaukhyu or Dawei in Myanmar. This will allow access to the remote hinterland via highways and rail, and allow mega vessels access to areas that were before unreachable result, it will strengthen connectivity in GMS regions and Indian Ocean regions.

This research study is based on a thorough review of the current literature examining the criteria that influence hub port choice, and of the

previous and current situations of major ports in the Bay of Bengal. There are certain limits in this study that will require future research.

First, the focus group had limited experience in answering questionnaires using this methodology. Furthermore, there was a limited amount of time available(1~2 hours) to interview each person. The sample size in this analysis is relatively small even though all respondents are high ranking individuals in the port related industries. A larger sample might provide better insights and strengthen the results.

Second, in this study, it would have been more beneficial if respondents from different countries had been interviewed. In order to overcome the potential bias in the weighting of criteria, it would be beneficial for more shipping lines and port users to be interviewed in order to determine the important weights of criteria in future studies.

Finally, it may be a good idea to add a cost-benefit forecasting analysis to the results of future potential regional hub ports. By complementing the limits of this study, more sophisticated method with more data collection work is recommended for further study, to obtain more persuasive results.

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벵갈만 지역의 컨테이너항만 선택 기준에 관한 연구

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국문요약

    본 연구의 목적은 스리랑카의 콜롬보항만, 인도의 첸나이항만, 방글라데시의 치타공항만 그리고 미얀마의 양곤항만을 포함한 벵갈만 지역의 주요 4대 컨테이너항만의 지역 허브항만 선택기준에 대해 실증분석하는데 있다. 연구 목적을 달성하기 위해 우선 항만선택기준에 관한 선행연구를 실시하였고, 선행연구를 통해 도출된 항만선택기준을 전문가 자문을 통해 분류하였다. 이를 바탕으로 항만의 이용자인 해운회사. 프레이트 포워더, 물류서비스 제공자 그리고 항만물류전문가를 대상으로 설문지를 배포하였다. 연구방법론으로 AHP가 사용되었다. 주요 연구결과를 요약하면 다음과 같다. 첫째, 항만의 효율성이 가장 중요한 항만선택기준으로 평가되었다. 다음으로는 항만 비용, 지리적 위치 그리고 항만시설 순으로 나타났다. 둘째, 항만의 상대적 평가에서는 콜롬보항만이 항만 배후단지를 제외한 네 요인에서 중요한 것으로 분석되었다. 본 논문은 벵갈만 지역의 허브항만 선택 기준에 관한 기초 연구를 실시하였다는 점에서 연구의 의의가 있다. 그럼에도 불구하고 전문가를 대상으로 한 설문 표본이 작다는 점과 벵갈만 지역 항만에 대한 폭넓은 지식을 가진 전문가를 찾아내기가 쉽지 않다는 점이다. 향후, 이런 점을 보완할 수 있는 연구를 수행해야 할 것이다.