Effects on Laem Cha Bang Port in Thailand after Completion of Dawei Port in Myanmar

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Abstract

In Thailand, there are two main ports for im-export--Laem Cha Bang Port (LCP) and Bangkok port. However, LCP has been serving as the only key port according to the higher capacity and water depth. Recently, other Southeast Asian countries have developed their own port to strengthen their logistics network. Especially, in Myanmar, several port projects, including Dawei deep seaport, are of interest to Thai and foreign investors. Somehow in the near future, LCP may face the port competition; similarly, it has been happening in European countries[1]. To prepare for the port competition in the future, understanding the factors influencing port selection is essential. The aims of this study are to identify the key factors affecting the port selection, to obtain the weight of each factor and to estimate the effects on LCP in terms of the change in import-export value. Fuzzy AHP is used in this study since it can handle with the multi-criteria decision making process and the vagueness of the answers. Five important factors namely port location, shipping frequency/destination, port efficiency, cost, and adequate infrastructure/facilities are addressed in this study. The information is collected via the web-based questionnaire. Two groups of decision maker--shipper and importer, are the target of the questionnaire. The results of this study will be beneficial to the related organizations; to be able to prioritize the factor to improve the satisfaction and keep the share of the existing port users.

Keywords: Dawei deep seaport, Laem Cha Bang Port (LCP), fuzzy AHP, port selection

Introduction

Trace back to 1940's, only Bangkok port served as the main port for im-exporting freight in Thailand. However, the limitation of the space and the depth of the water cause difficulties to the port in terms of handling larger ship and future economic growth. Thai government thus established a plan to construct a new seaport to eliminate the limitations. Laem Cha Bang Port (LCP), to satisfy the needs of long-term economic development, has been constructed and operated since 1991. LCP soon became the main port of Thailand with the area of 10 km^2 and the water depth of 14 meters.

Waterborne transport is the most favored mode for freight transport since it is the cheapest way to transport freight to countries located in the certain distances. To minimize the transport cost, plus the advance of engineering, the ship or fleet size is bigger built. However, without adequate infrastructure, the development of ship itself is useless. Port is the other essential infrastructure for the effective waterborne transport. In recent years, Southeast Asian countries realized the importance of the port as the key component to reduce the freight transportation cost. Apart from Singapore and Malaysia, those own ports have been operating as a main hub in the region, other countries continuously develop their own ports. For example, Vietnam has developed several ports, especially Da-nang port, to be able to satisfy the needs of increasing freight volume. On the other hand, located in the Andaman Sea, Myanmar is attractive to the investors especially those from Thailand. Development projects has been initiated, especially, Dawei special economic zone, including the Dawei deep seaport. According to the location of the port, port size and construction plan, there is a possibility that Dawei port will become a competitive port to LCP.

According to the trend of port competition in Greater Mekong Subregion (GMS) countries in the near future, LCP can possibly face a hard time in loosing share on port utilization. To prepare for the competition, understanding the factors and the mechanism of decision making on port selection is needed. In addition, an estimation of changes in future can give a clearer picture and lead to the better preparation. Several effective strategies and a clear direction of development are very important. The objectives of this study, thus, are to identify the key factors affecting port selection of the decision maker in Thailand, to understand the decision-making process of the decision makers in Thailand and to estimate the effects of Dawei port on LCP in terms of the change in trade value through the port in different scenarios.

Literature review

Port competition exists all over the world. The users of these ports are not only in the countries those directly connect to the ocean but also extend to the country located in hinterland area[1].

Three main groups of the decision makers involving in port selection are shipper, importer and freight forwarder. Literatures show that the port preferences of the decision makers vary according to factors. The varieties are not only among makers in different countries but also among the different group of the makers. The order of important factors for port selection is different between the freight forwarders in Thailand and Malaysia. The study describes that the importance of cost is higher than the port efficiency due to the low value-added of the goods[2]. On the other hand, the effect of price is more sensitive to freight forwarders than shippers[1]. Despite the independent influence from each factor, the compensatory interaction is also appeared. Likewise, one strong performance factor can compensate other poor performance factor for the case of RoRo transportation[3].

With regard to various factors, port selection can be viewed as a multi-criteria decision making (MCDM) problem. Analytic hierarchy process (AHP) is widely used to analyze MCDM problems. AHP breaks down the structure of the problem into levels as shown in Fig. 1. However, the traditional AHP cannot reflect the human answer which is ambiguous. Fuzzy set theory[4], developed by Zadeh, is able to model the

imprecision of the answer by using a membership function in preference to a crisp value.

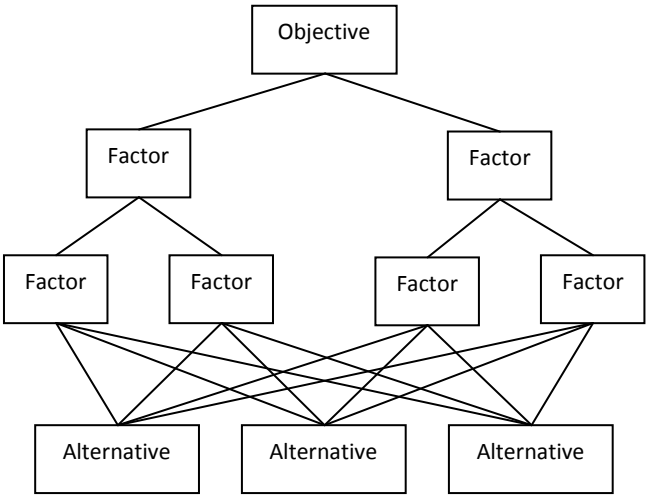

Fig. 1 Hierarchy of AHP

An extend application, Fuzzy AHP, is an alternative to analyze the complex comparison with vagueness of human answer. Several approaches have been developed to extract the priority vector. However, each approach is done by the following steps of fuzzy logic analysis as shown in Fig. 2.

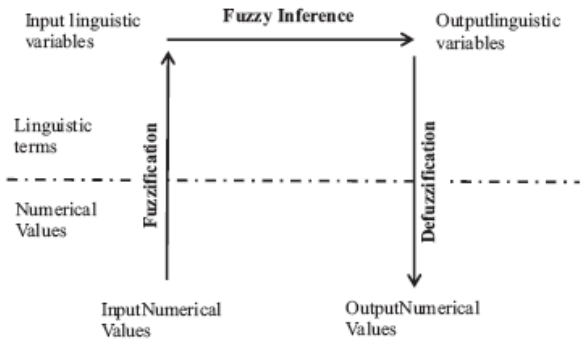

Fig. 2 Fuzzy logic system[5]

The extent analysis method is developed to handle fuzzy AHP[6]. Assume that M_1 (l_1, m_1, u_1) and M_2 (l_2, m_2, u_2) are triangular fuzzy numbers. The operations of two sets are as follows:

$$M_1 + M_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2) \quad (1)$$

$$M_1 \otimes M_2 \approx (l_1 \otimes l_2, m_1 \otimes m_2, u_1 \otimes u_2) \quad (2)$$

$$M_1^{-1} \approx (1/l_1, 1/m_1, 1/u_1) \quad (3)$$

The value of fuzzy synthetic extent can be obtained from Eq. (4)

$$S_i = \sum_{j=1}^{m} M_{g_i}^{j} \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^{j} \right]^{-1} \quad (4)$$

The degree of possibility of M1≥M2 is defined as

$$V(M_1 \geq M_2) = hgt(M_1 \geq M_2) = \begin{cases} 1, & if \quad m_2 > m_1 \\ 0, & if \quad l_1 > l_2 \\ \dfrac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & otherwise \end{cases} \quad (5)$$

The non fuzzy weight vector W can be obtained from Eq. (6).

$$W = (\min V(S1 \geq Sk), \min V(S2 \geq Sk), \ldots, \min V(Sn \geq Sk))^T \quad (6)$$

Methodology

Several assumptions have been made to simplify the complexity of the activities in port selection. The first assumption is that there is only one decision maker in each company or the decision is made in the same direction if there is more than 1 maker. Each company will select only one port to transport the freight. Moreover, if the company has a right to select the port, it happens to all 100% of the trade.

A questionnaire is developed and used to collect the port preferences of shipper and importer. The questionnaire comprises 3 parts: information of respondent and the company, pair-wise comparisons of the port-selection factors and evaluation for each criterion from scenarios. Since the decision maker of each company works in the different position in the company and the location of each company is scatter over Thailand, traditional direct distribution is impossible with the time and budget limitation. Alternatively, literature shows that the distribution via e-mail is possible[1];

however, the response rate is low—by 10%. In this study, a web-based questionnaire is developed together with the database management system to collect the information from the decision makers.

Two strategies are used to distribute the questionnaire. The first approach is to send the link of the questionnaire via the e-mail addresses of exporters. The advantage is that the questionnaire is sent to almost exporting companies. However, the mail does not go to the decision maker directly since most of the emails are central email. To improve the efficiency of the distribution, a direct contact by calling to the each company is done as the second strategy. This approach takes longer time, results in small number of company approached; yet, it is more efficient. Unlike the first approach, the questionnaire is sent directly to the decision makers after a confirmation of their understanding and right to select an im-export port. Moreover, this approach can immediately return the fundamental information about the company and able to capture other detailed factors those are not addressed in the questionnaire.

The trade value of im-export companies those have used LCP for latest three consecutive years is classified into groups. Total 7 groups with different trade value per year (2012) are less than 1 million Baht, 1-10 million Baht, 10-100 million Baht, 100-1,000 million Baht, 1,000-10,000 million Baht, 10,000-70,000 million Baht and over 70,000 million Baht. Finally, approximate 4,000 import and 7,000 export companies are the target of this study.

For the pair-wise comparison, total 5 factors are addressed which are port location, shipping frequency/destination, port efficiency, adequate infrastructure and cost. To analyze the weight of factors using AHP, the consistency check, to exclude the invalid data, is necessary. The Consistency Ratio of the valid data must be less than 0.10.

The valid data is aggregated using geometric mean as shown in Eq. (7). The basic operation is done following Eq. (1), Eq. (2) and Eq. (3).

$$\mathrm{l}_{\mathrm{ij}} = \prod_{k=1}^{K} l_{ijk}, \mathrm{m}_{\mathrm{ij}} = \prod_{k=1}^{K} m_{ijk}, \mathrm{u}_{\mathrm{ij}} = \prod_{k=1}^{K} u_{ijk} \qquad (7)$$

The extent analysis[6] is used to obtain the weight vector from the aggregated data.

For the evaluation of criteria from scenarios, the conditions of each criterion of Dawei port and LCP are made by assumption according to the available information. Four cases of the conditions are selected—the present condition of LCP, improved LCP, Dawei port with 20% better than present LCP and Dawei port with 40% better than present LCP. Consequently, total 8 scenarios of comparison are constructed as shown in table 1.

Table 1 Details of scenarios

Scenario	Details	
	Port condition	Destination/ Origin
1	Present LCP-Dawei (20%)	Leftside
2	Present LCP-Dawei (20%)	Rightside
3	present LCP-Dawei (40%)	Leftside
4	Present LCP-Dawei (40%)	Rightside
5	Improved LCP-Dawei (20%)	Leftside
6	Improved LCP-Dawei (20%)	Rightside
7	Improved LCP-Dawei (40%)	Leftside
8	Improved LCP-Dawei (40%)	Rightside

Estimation of the change in trade value from LCP to Dawei is performed according to the Eq. (8) and Eq. (9).

$$\mathrm{a} = \sum \left(\frac{\mathrm{b}}{\mathrm{c}} \times \frac{\mathrm{d}}{\mathrm{e}} \times \mathrm{f} \times \mathrm{g}\right) \qquad (8)$$

a = trade value shared from LCP to Dawei port
b = the number of samples preferring Dawei port
c = the number of valid samples those have a right to make the decision

d = the number of samples those have a right to make the decision
e = the number of total samples
f = the number of companies those belong to each group categorized by trade value
g = average trade value per year of the group

The shared trade value is calculated by percentage by the Eq.(9).

$$h = \frac{a}{i} \qquad (9)$$

a = trade value shared from LCP to Dawei port
h = percentage of trade value shared
i = summation of trade value calculated from each group categorized by trade value.

Results

In this study, the respondents are shipper and importer. Among total 48 responses from the shipper those have the right to select the port, 6 of them are invalid due to the inconsistency. On the contrary, 4 out of 36 responses from importer those have the right are invalid. The results from fuzzy AHP analysis shows that "cost", "port location", shipping frequency", adequate infrastructure and port efficiency are the most crucial factor, respectively, for both shipper and importer. The weight of each criterion is shown in table 2.

Table 2 Weight of each factor affecting port selection of shipper and importer

Factor	Weight	
	Export	Import
Cost	0.310	0.284
Port location	0.251	0.230
Shipping frequency	0.238	0.210
Adequate infrastructure	0.111	0.162
Port efficiency	0.090	0.114

The data of port preferences can be only obtained from the questionnaire. Differently, the data used for estimation the change in trade value can be obtained from both questionnaire and the direct contact. The information is summarized from both the direct contact and the questionnaire. From total 103 shippers, 69 of them have the right to select the port. In the case of importer, 215 out of the 220 importers have the right to select the destination port.

From the evaluation of each factor from scenarios, the company will choose the port that accounts for higher total score. Since there are two ports in the study, only companies those tends to choose Dawei port is focused. The shippers and importers those will select Dawei port is also categorized into groups by trade value per year. The share of trade value from LCP to Dawei port is calculated according to Eq. (8) and Eq. (9). The results are shown in table 3.

Table 3 Share of trade value from LCP to Dawei port

Scenario	Share (export)	Share (import)
1	9%	2%
2	9%	2%
3	19%	16%
4	13%	16%
5	9%	1%
6	9%	1%
7	10%	16%
8	10%	15%

Conclusion/Discussion

The advantages of the web-based questionnaire are the ease for respondent to return the answers and for the data summary. However, several companies are uncomfortable to provide the information via the website. A good alternative would be an interactive pdf file together with the web-based questionnaire.

According to the results, ranking from the most important factor, "cost", "port location", shipping frequency", adequate infrastructure and port efficiency are the most crucial factor, respectively. Although the inland transportation cost is the dominant cause in the difference of the transportation cost, the compensation can be available from shipping lines with various fleet sizes and charges. Cost, or can be expressed in term

of total cost, is thus more important than the port location, which clearly affects the inland transportation cost. Apart from the cost, travel time is another factor that port users emphasize. The shorter travel time, normally comes with the closer port location, reflects the ease of any document corrections in case there are errors. Plus, it reduces the buffer time for an on-time delivery. Shipping frequency is another important factor to ensure the on-time delivery. The higher shipping frequency, the less buffer time both in transportation and production. Adequate infrastructure and port efficient are almost neglected from the user once they satisfy the basic needs of the users. Moreover, most of the shippers and importers do not directly deals with operations inside the port area since they usually use a freight forwarder or shipping company. The most important point, that has a potential to change the results on the weight of each factor, is that most of these port users do not have a full perception of the port competition.

The outcomes from scenarios show that the effect of Dawei port on LCP is not strong. Although the conditions of Dawei is 40% better than present condition of LCP which is the best case for Dawei port, the share of the trade value is only found to be by 16% for both export and import. The effects of Dawei port on LCP, for export, in the case that the conditions of the port is 20% and 40% better than LCP are slightly different at 10% change. On the contrary, for import, the effects are clearly different. However, the change in the results can simply due to the small number of the responses belong to each group. In addition, the calculation is possible only in certain groups.

In order to keep the share of trade value on LCP, the related organizations are to improve those important factors by prioritization. Cost is the first priority to be improved. Two main costs that can affect the total cost are freight charge and inland transportation cost. Between the two factors, inland transportation is more crucial. An infrastructure, for example, effective rail system, should be developed since it can reduce the cost and increase the reliability of the inland freight transport. While increasing the shipping frequency is quite difficult, since it directly related to the shipment quantity, the improvements of infrastructure and port efficiency account for higher possibility.

References

[1] De Langen, P.W. (2007) Port competition and selection in contestable hinterlands; the case of Austria, *European Journal of Transport and Infrastructure Research*, vol.7, no.1, pp.1-14

[2] Tongzon, J. (2009) Port choice and freight forwarders, *Transportation Research Journal Part E*, vol.45, pp.186-195

[3] Mangan, J, Lalwani, C and Gardner, B. (2002) Modelling port/ferry choice in RoRo freight transportation, *International Journal of Transport Management*, vol.1, no.1, pp.15-28

[4] Zadeh, L.A., (1965) Fuzzy Sets, *Information and control*, vol.8, pp.338-353

[5] Ceder, A, Chowdhury, S, Taghipouran, N and Olsen, J. (2013) Modelling public transport users' behavior at connection point, *Transport Policy*, vol.27, pp.112-122

[6] Chang, D.-Y. (1996) Applications of the extent analysis method on fuzzy AHP, *European Journal of Operational Research*, vol.95, pp.649-655