Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Transshipment hub selection from a shipper's and freight forwarder's perspective

Gang Chen\textsuperscript{a}, Waiman Cheung\textsuperscript{b}, Sung-Chi Chu\textsuperscript{c}, Liang Xu\textsuperscript{d,}\textsuperscript{*}

\textsuperscript{a}Department of Management, Lingnan (University) College, Sun Yat-sen University, Guangzhou, China
\textsuperscript{b}Department of Decision Sciences and Managerial Economics, The Chinese University of Hong Kong, Shatin, Hong Kong, China
\textsuperscript{c}Centre of Cyber Logistics, The Chinese University of Hong Kong, Shatin, Hong Kong, China
\textsuperscript{d}Department of Supply Chain and Information Systems, Smeal College of Business, Pennsylvania State University, 419A Business Building, Penn State University, State College, PA 16801, United States

\begin{abstract}
Transshipment hub selection becomes increasingly important to the global logistics community. From the perspectives of shippers and freight forwarders, a selection must align with cost control strategy and sustain service reliability across cooperative service providers. This paper assesses the selection with the options of both sea and air transports, and from the influence of country of origin of the company. Critical factors of transshipment hub selection, both qualitative and quantitative, are identified through focus group discussions. Relative importance of these factors is determined based on collective views of logistics stakeholders. The competitiveness of transshipment hubs is then assessed using an AHP approach. Our analysis is based on the historical implementation of direct transportation link policy between Mainland China and Taiwan. With this empirical work, the finding suggests that even the spawm of other nearby ports with shorter transport distance and closer proximity to cargo sources, there remain overriding factors such as customs regulations & government policies and connectivity that a transshipment hub is preferred.
\end{abstract}

2017 Elsevier Ltd. All rights reserved.

1. Introduction

Thanks to economic globalization, products on the market are most likely coming from the other part of the world for improving profit margins and necessitating keen global logistics strategy (Van Hassel, Meersman, de Voorde, & Vanelander, 2013). Global cargo logistics entails multiple logistics nodes and the cooperative planning of multiple logistics stakeholders (Carlan, Sys, & Vanelander, 2016). The connectivity of these nodes, e.g., distribution centers, sea container ports, airports, and transshipment hubs, becomes crucial for effective shipment planning. In cases where global supply chains with high tonnage and volume, the selection of a transshipment hub over a cargo flow becomes increasingly important to cost control and service reliability in the daily operations of logistics stakeholders.

Currently, the global logistics market has been witnessing the increasing use of transshipment transport (Jiang, Lee, Chew, Han, & Tan, 2012). An increasing number of ports emerge as transshipment hubs, and some only provide transshipment service (Baird, 2006; Meersman, de Voorde, & Vanelander, 2016). Traditionally, a transshipment port may act as simple as passing freight between ships and landside transport. Recently, a transshipment hub could include container terminals, cross-docks, consolidation centers, and other facilities beyond seaports and airports (Vis & de Koster, 2003). Thus operating a transshipment hub becomes complicated (Petering & Murty, 2009), such as storage yard management. Furthermore, selecting a transshipment hub is neither trivial nor straightforward. The selection has to assess transshipment hubs within the context of regional or global logistics network. It has to concern more on the connectivity among multiple ports, rather than the operational effectiveness of a single port. It may also need to consider the cross-boundary issues involved.

Referring to existing literatures on port selection, when it comes to the selection of a transshipment hub, we believe there are three overarching concerns that one would consider. Firstly, logistics stakeholders could prefer different transshipment hubs in global logistics due to their different business role. Shippers and freight forwarders often select a transshipment hub based on strategic and operational concerns respectively. For instance, shippers could make their strategic chain choice based on spatial
value, and organizational driving forces (Shi & Li, 2016). Shippers could operationally select a transshipment hub to align the strategic requirement, when ports are choices in hubs with different governmental regulations and service quality and efficiency (Steven & Corsi, 2012; Talley & Ng, 2013). While from forwarders’ perspective, the hub selection is the core to strategic route optimization, which could considerably affect on-time delivery, operational efficiency, and service quality in cargo handling and customs clearance (Chu, 2014; Lirn, Thanopoulou, Beynon, & Beresford, 2004; Nugroho, Whiteing, & de Jong, 2016; Tran, 2011).

Secondly, both sea and air transports should be options to be considered concurrently. The primary concern is the varying aspects of cargo flow. Nowadays, it is a common practice for logistics service providers and airlines to transport cargo from Asia via ocean to the Middle Eastern freight hub and then transfer to an aircraft for the second leg of the journey to Europe or Latin America (Kulisch, 2016). In Northern Canada, it has been witnessed that water conditions impact shippers’ route choice decisions and the overall performance of multimodal freight transport systems (Du, Kim, & Zheng, 2017). Here an intermediate operator (e.g., shipper, carrier, or terminal operator) typically designs her service products by following dynamic allocation policies of resources (e.g., air and sea resources), and make her route choice based on the intermodal transportation network (Wang & Meng, 2017; Wang, Wang, & Zhang, 2017). Both the real-world practices and the relevant academic studies endorse that when selecting a transshipment hub, the services related to both sea and air transports should not be assessed in isolation.

Thirdly, a company’s country of origin could be a concern in the stakeholder’s shipping strategy influencing the choice of a port simply. The effect of country of origin has been extensively studied in strategic management and organizational behavior (Song, Calantone, & Anthony, 2002). Country of origin, when associated with products, could be regarded as synonymous of high quality and original design, influencing the value perceived by the customers (Insch & McBride, 2004). It could also be a critical factor affecting particular strategic decision making, such as supply chain configuration of the firms (Brun et al., 2008; Teng & Jaramillo, 2005). Other literatures have suggested that companies with different country of origin could have significant different emphasis in strategic decision making (Demirbag, Tatoglu, Glaister, & Zaim, 2010; Harzing & Sorge, 2003). Similarly, in our study, a company’s decision makers are likely to have deeper understanding of the ports in the region where their company originally established and more concrete knowledge of their country’s unique competitive edge as a selling point in the market. The inherited know-how could influence decision makers’ preference in choosing a transshipment hub.

To explore causation of the above concerns on transshipment hub selection, we select the case about Hong Kong and Taiwan from the population of ports in Asia. It is interesting to note that nine of out of the top ten container ports are in Asia and they are all competing for transshipment cargo. In this paper, Hong Kong and Taiwan’s current role as a transshipment hub are examined in the greater China region where direct transportation link (DTL) policy has been implemented. As a transshipment hub, Hong Kong has enjoyed a steady increase in cargo flows since 2005.1 Hong Kong’s transshipment hub status is unwavering as there is a lack of transportation policies between Taiwan and the Mainland. However, the DTL policy opens direct cargo flow, by sea and air, across the Straits between Taiwan and the Mainland China. Without direct flights to Taiwan from the Mainland, many thousands of Taiwanese companies based in Guangdong and Fujian provinces have to hub their components and finished products in their export operation through Hong Kong. Now related logistics stakeholders in the region have to carefully frame the global transport network and select transshipment hub accordingly.

In the following sections, we first review relevant literatures and develop a research framework for this study. Having a number of group discussions with logistics practitioners, we formulate logistics stakeholders’ decision model as an analytical hierarchy that is generic for transshipment hub selection. Using the specific case of Hong Kong and Taiwan provides a unique opportunity and focal point for discussions among participants. We can then determine the relative importance of the decision concerns. We also conduct a comprehensive comparison between the two hubs to further examine the diversity of logistics stakeholders’ views. Discussion on managerial implications is provided to enhance the generalization of this study in the last section.

2. Literature review

In the prior research, selection of a transshipment hub has been seldom studies. Instead, sea port selection problem has been extensively studied in the last decade, with respect to dominant sea freight regions, such as Greater China (Lirn, Thanopoulou, & Beresford, 2003), Southeast Asia (Tonzon, 2009), Western Asia (Sayareh & Alizmini, 2014), North American (Guy & Urli, 2006; Steven & Corsi, 2012), and European area (Onut, Tuzkaya, & Torun, 2011). These single transportation mode studies were conducted from the perspective of logistics stakeholders in the sea transport community. For instance, Nir, Lin, and Liang (2003) examined Taiwan shippers’ behavior when making selection among the three local sea ports, while Lirn et al. (2004) studied the same set of ports from the perspective of global ocean container carriers. These studies provided an understanding of sea port selection in key global regions. More recently, Wang and Hong (2011a) argued, with respect to air freight transportation, Taiwan had taken on this endeavor to gain competitive advantages under Direct Transport Link policy. In our study, we are not looking at selection of a single-modal port among competitive ones in a region, but rather at the selection of a transshipment hub, where choices of different modals are presented, in the context of global cargo logistics.

Moreover, methodologies used in most existing port selection studies were either economic models or statistical analysis, offering what is relevant, but did not provide us the understanding of strategic and operational concerns in transshipment hub selection. Malchow and Kanafani (2004) proposed a discrete choice model for selecting a US port for maritime shipments. Chou (2007) applied fuzzy multiple criteria decision making method (MCDM) in selecting a transshipment container port. Based on the Air Cargo Supply Chain Operations Reference (ACSCOR) model, Low, Yuan, and Tang (2008) conducted a statistical analysis to study competitive advantages of Hong Kong and Singapore ports. Alonso and Sanchez-Soriano (2009) analyzed actual inter-port traffic distribution using a discrete choice modeling approach, and investigated impacts of port location on port selection from the perspective of hinterland.

Other studies made use of AHP approach to identify and assess critical factors in the port selection from a particular perspective of logistics stakeholders, with respect to single ports of different nature. Both AHP-based studies conducted by Lirn et al. (2003, 2004) found that, from a carrier’s perspective, factors of port location and carrier cost were more important than factors of port management and port physical characteristics in the port selection. Song and Yeo (2004) conducted a competitive analysis of major Chinese container ports by using AHP approach. The study also identified port location is an important concern, while insufficient

---

1 An exception in 2009 due to SARS (severe acute respiratory syndrome) outbreak.
facility was more important than the lack of service in building up the competitiveness of Chinese container ports. Sanchez, Ng, and Garcia-Alonso (2011) investigated major attributes in port selection. From the port service provider’s perspective, the empirical study indicated that time efficiency, cases of delays and accessibility of ports as the core factors affecting port attractiveness.

From the perspective of shipping lines, the AHP study of Guy and Urdi (2006) examined whether the existing four important concerns, i.e. port infrastructure, total transit cost, service, and geographical location, were suitable to account for the selection of New York and Montreal ports. Chang, Lee, and Tongzon (2008) performed exploratory and confirmatory factor analysis in shipping lines’ port selection with main haul services between East Asia and Europe. This study identified five important factors, including advancement/convenience of port, physical/operational ability of port, operational condition of shipping lines, marketability, and port charge. Recently, Wang, Jung, Yeo, and Chou (2014) studied the cruise lines’ port selection using the fuzzy-AHP method. The study specified the most considerable factor, i.e. tourism attractions, which is problem-specific and two important concerns, i.e. connectivity and agility and terminal facilities, which are general in port selection. In the context of West Africa, the AHP study conducted by Gohomene, Yang, Bonsal, Maistralis, Wang, and Li (2016) has identified port infrastructure as the most crucial factor, along with other important concerns, including port draught, political stability, market size, and international networks.

Onut et al. (2011) formulated a production firm’s selection of container ports within the Marmara region as a fuzzy AHP model, which examines six major criteria, i.e. port location, hinterland economy, physical features of port, port efficiency, cost, and some others. Ahn, Lee, and Han (2014) examined port selection of import and export companies in metropolitan areas trading with China and they identified a set of relevant concerns, including port fee, ocean freight changes, and port information services. It is found that port location and cost were typically important factors in a variety of research contexts.

In our study, all of these factors mentioned above will be presented to different logistics stakeholders for consideration. The transshipment hub selection problem is based on intermodal freight transport practices, and views from—logistics service providers (e.g. freight forwarder) and cargo owners (e.g. shippers)—have to be collected.

3. The research framework

In practice, selecting a transshipment hub is a complex decision making process. Both tangible and intangible decision criteria are involved. A logistics stakeholder (e.g. a shipper or a freight forwarder) may simultaneously consider many criteria (factors) such as port location, delivery costs, service reliability, and custom regulations. A criterion often consists of multiple attributes (sub-factors). The relationships among criteria and their attributes can be offered in a hierarchy for evaluation. Therefore, it is important to formulate and structure a comprehensive framework to better understand the selection of a transshipment hub from the perspectives of logistics stakeholders.

The Analytic Hierarchy Process (AHP) is capable to combine both subjective and objective perceptions into a framework based on ration scale (Ramanathan, 2013; Saaty, 1990; Yang, Hui, Leung, & Chen, 2010). AHP is a flexible and powerful approach to measure both tangible and intangible criteria. With AHP, an expert develops multiple decision criteria with a hierarchy and assesses the relative importance of these criteria by comparing each pair of the criteria—that is, a pairwise comparison process. Pairwise comparison can be conducted by surveying either the whole population or a sample of qualified decision-makers (Hughes, 2009; Lin et al., 2003). With the relative importance of all the criteria, the overall ranking of the alternatives is then calculated. The rating is rather subjective and is based on the experience and expertise gained by the respondents. Therefore, AHP studies commonly take samples of experts or participants from top management teams (e.g. chief executive officer, general manager, or division director) of relevant organization(s) from professional industrial communities (Di Gravio, Patriarca, Mancini, & Costantino, 2016). Representative group judgments could be then obtained by aggregating individual weights through geometric mean (Van Den Honert & Lootsma, 1997).

Traditionally, using AHP in solving a decision problem involve four steps: firstly, establishing an analytical hierarchy with identified factors and attributes; secondly, collecting input data by pairwise comparisons of the decision elements; thirdly, estimating the relative priorities of these elements in the hierarchy; and lastly, obtaining the overall ranking of the alternatives (Johnson, 1980; Zahedi, 1986). Here we propose an AHP-based analytical framework, which consists of three steps to reveal the collective views of logistics stakeholders on selecting a transshipment hub in the business context (Fig. 1). Note that this research framework is in line with the above traditional four-step approach. Step 1 and Step 2 of this study are in line with the traditional first and the second steps, respectively. In Step 3, we deduce the collective views of logistics stakeholders based on the individual relative weights and ratings. This step combines the computation works of both the traditional third and fourth steps.

**Step 1:** Identify critical factors of transshipment hub selection through group brainstorming. The brainstorm sessions are conducted open-ended with industry experts and professors in domain knowledge.

AHP suggests decomposing a decision problem into a hierarchy of associated elements. The decision hierarchy is constructed by indicating an ultimate goal of such a decision and/or assessment on the top level of the hierarchy, and specifying their attributes in the respective levels of the hierarchy. In our study, the ultimate goal is the preferences of decision makers on selecting a transshipment hub; the lower levels of the hierarchy contain decision criteria and their respective attributes which derived from collective views of industrial experts.

With brainstorm sessions, collective views of industry experts on the decision criteria are collected. The critical criteria can then be identified and the hierarchy can be developed. A comprehensive questionnaire for the AHP analysis can be subsequently developed based on the identified criteria.

**Step 2:** Determine individual preference in choosing a transshipment hub based on face-to-face interview with experts. Interviews with individual experts are held to understand the correlation of the identified factors. Major concerns of selecting a transshipment hub by the individual stakeholders are identified.

The relative importance of the hierarchical elements is determined. Factors are compared pair-wisely so as to determine relative weights of each in contributing to the goal, i.e., the com-
petitiveness of transshipment hub. The relatively important factors should have relatively higher weights, and been given more attention in making a decision.

Step 3: Obtain the collective views of logistics stakeholders by aggregating AHP factor rankings of experts. The analysis is based on individual ratings and involves a consistence test. The computational procedure on “weights” as suggested by Saaty (1980) is followed. Here the eigen value method is used to estimate the relative weights of the criteria in determining the selection of a transshipment hub. Corresponding mathematical illustration is as follows.

Based on the survey in Step 2, an expert’s judgments can be represented as a n by n pairwise comparison matrix A, where n denotes the number of factors involved. In matrix A, aij measures the relative importance of factor i against factor j. The relative importance varies from 1 to 9, where 1/1 indicates equal importance and 9/1 indicates extreme importance. According to the reciprocal property of A, aij = 1/aij for all i ≠ j, and aii = 1. Then,

\[ A = (a_{ij})_{n,n} = \begin{pmatrix} 1 & a_{12} & \cdots & a_{1n} \\ a_{21} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{pmatrix} \]

In practice, inconsistency may occur, i.e., aijajk ≠ aik. According to Saaty (1990), the weight w = (w1, w2, ..., wn) can be approximated by solving Aw = λ max w, where λ max is the principal eigen value of A. Moreover, Saaty (1990) suggests that if A does not have any inconsistency, then λ max = n; otherwise λ max > n. The more consistent A, the closer λ max is to n. Based on this property, the consistency index (CI) can be defined as:

\[ CI = \frac{\lambda_{\text{max}} - n}{n - 1}. \]

We examine the CI for each interviewee to ensure the quality of the responses.

Once obtaining the weights for each interviewee, i.e., wk = (w1k, w2k, ..., wnk), where k = 1, ..., K is the index of interviewee within a group, we construct representative group judgments wG = (w1G, w2G, ..., wKG) by aggregating individual weights through geometric mean, i.e., \[ w_{G} = \left( \prod_{k=1}^{K} w_{1}^{k} \right)^{1/K} \] (Van Den Honert & Lootsma, 1997). Then wG is normalized such that \[ \sum_{i} w_{G}^{i} = 1. \]

4. Exploring transshipment hub selection using case study

4.1. The analytical hierarchy of selecting a transshipment hub

In this section, we formulate logistics stakeholders’ decision model as an analytical hierarchy with identified factors and their respective attributes. To obtain a comprehensive view, we invite industry experts from both sea and air freight communities to prescribe their decision process and concerns. Through group discussion, we identify critical decision concerns based on their individual experiences using the case of Hong Kong and Taiwan as an example, in selecting a transshipment hub. These sessions facilitate the exchange of real-world practices and know-how in an effort to reach an articulation and understanding of explicit and implicit concerns, which are generic in the hub selection.

Stakeholders involved in cargo logistics from or to Mainland China are included. Both sea and air freight will be looked into for cargo flow which related to cross-strait transportation. Shippers are considered as service receivers, while third party freight forwarders (3PLs) are service providers who involve in designing cargo movement routes. Besides, concerns of sea freight and air freight forwarders could be different. For example, a sea freight forwarder may consider using Port A rather than Port B in terms of ocean connectivity to the world, while an air freight forwarder may consider Port B rather than Port A in terms of the cost incurred.

The country of origin of the company is used in this study instead of where the company is geographically located. A shipper owned by Taiwanese company, whose branch is located in Hong Kong, is considered as a Taiwanese shipper. It is believed that corporate executives have familiarity or knowledge of the port in the region where the company established. Here, shippers, 3PLs-sea and 3PLs-air are further classified by regions as “Taiwan” and “Hong Kong”.

Therefore, stakeholders are classified into 6 groups as follow: (1) Hong Kong shippers, (2) Hong Kong 3PLs-air, (3) Hong Kong 3PLs-sea, (4) Taiwan shippers, (5) Taiwan 3PLs-air, and (6) Taiwan 3PLs-sea. We invited 27 experts, all of them are senior executives with substantial experience (over 20 years) in trade, manufacturing or logistics business within/between Greater China and overseas. They are carefully selected with fair representations of air/sea mode of transportation, logistics/shippers as well as Hong Kong/Taiwan. The experienced participants with similar focus (i.e. being a certain business role) are then divided into groups of three to four each, so as not to disturb the discussion focus or dilute the difference among stakeholders. Note that here focus group sessions aim to explore opinions, attitudes, and decision concerns of certain stakeholders, rather than create innovative solutions to particular problems. While participants of a group vary in terms of gender, educational background, working experience, and management positions, the group could benefit from the synergy in generating opinions and highlighting decision concerns with respect to the certain business role. Table 1 shows the number of participants in each group.

In each group discussion, the experts brainstorm the important factors and the preferences in choosing a transshipment hub for around 45 min. Then, a preliminary AHP hierarchical structure is distributed to each expert to collect their comments on the design for 30 min. We initiate and coordinate each group discussion by defining factors and questioning the group members the issues and concerns in selecting a transshipment hub.

Comments are collected and recorded for review. Similar comments are aggregated and the frequency mentioned by experts is also calculated. A preliminary AHP questionnaire is reviewed with the aggregated opinions as attributes. The related attributes are then further grouped into a factor. The discussion has been conducted with the six individual groups, where the questionnaire is revised after each brainstorm session.

The experts’ opinions are summarized and formulated to a finalized AHP hierarchical structure. As a result, 8 critical decision criteria (factors) with their corresponding attributes are identified. They are location, cost of route, facility, connectivity, port service, cargo information, customs regulations & government policies, and legal & financial service. These criteria consist of a total of 21 attributes (sub-factors). Table 2 shows the 8 criteria and the 21 sub-criteria. A finalized AHP questionnaire is then constructed.
Table 2
AHP questionnaire factors formation.

| Factors | Sub-factors | Explanation |
|---------|-------------|-------------|
| 1. Location | 1.a Geographical location | Physical position on earth, e.g., distance to transport facilities as well as to main navigation routes (Chang et al., 2008; Gohomene et al., 2016; Guy & Urfi, 2006; Lirn et al., 2003; Lirn et al., 2004; Onut et al., 2011; Sanchez et al., 2011; Song and Yeo, 2004; Tongzon, 2009; Wang, Hong, Chen, & Jiang, 2011b) |
| 1b Natural factors | | Susceptibility to natural assurance or hazards such as water depth and severe weather (Chang et al., 2008; Lirn et al., 2003) |
| 1c Catchment area | | Coverage of industrial structure, and economy strength of nearby area where the hub is located (Gohomene et al., 2016; Guy & Urfi, 2006; Onut et al., 2011; Wang & Hong, 2011a) |
| 2. Cost of route | 2.a Total costs | Costs associated with transhipping through the hub, including transit cost, carrier loading/discharging cost, insurance, potential penalty on delayed delivery, etc. (Lirn et al., 2003; Lirn et al., 2004; Guy & Urfi, 2006; Tongzon, 2009; Onut et al., 2011; Ahn et al., 2014; Gohomene et al., 2016) |
| 2b Variety of choices for services and rates | | Availability of alternatives services with different levels of costs in the hub (Tongzon, 2009) |
| 3. Facility | 3.a Storage/backup space | Availability of storage and buffer area in the hub (Lirn et al., 2003; Song & Yeo, 2004; Sanchez et al., 2011) |
| 3.b Facility efficiency | | Readiness and ability in loading/discharging cargos, shipment consolidation, etc. (Tongzon, 2009; Onut et al., 2011; Sanchez et al., 2011) |
| 3.c Multi-modal transport interface | | Accessibility to different transport modes, such as airway, waterway, railroad, highway, etc. (Lirn et al., 2003; Lirn et al., 2004; Tongzon, 2009; Guy & Urfi, 2006; Onut et al., 2011) |
| 4. Connectivity | 4.a Connection to major ports | Availability of direct route to major ports (Sanchez et al., 2011; Ahn et al., 2014) |
| 4.b Frequency of calling vessels/flight | | Number of flights/vessels going between the hub and other major ports within a time period (Lirn et al., 2003; Tongzon, 2009; Onut et al., 2011; Steven & Corsi, 2011b; Ahn et al., 2014) |
| 5. Port Service | 5.a Cargo security & safety | Provision of surveillance and protective processes to prevent cargo thief, hijack or damage (Lirn et al., 2003; Song & Yeo, 2004; Tongzon, 2009; Onut et al., 2011; Sanchez et al., 2011; Ahn et al., 2014; Gohomene et al., 2016) |
| 5.b Service reliability | | Trustworthiness and on time service (Song & Yeo, 2004; Lirn et al., 2004; Guy & Urfi, 2006; Chang et al., 2008; Tongzon, 2009; Sanchez et al., 2011; Onut et al., 2011; Ahn et al., 2014; Gohomene et al., 2016) |
| 6. Cargo Information | 6.a Cargo information availability | Cargo information, such as real-time location and carrier information, exists and is correctly updated (Chang et al., 2008; Onut et al., 2011; Ahn et al., 2014) |
| 6.b Cargo information accessibility | | Convenient, handy, and timely for stakeholders via different communication channels (Chang et al., 2008; Tongzon, 2009; Ahn et al., 2014) |
| 7. Customs regulations & government policies | 7.a Simplicity and transparency of customs procedures | Straightforward, clear, and informed customs process (Lirn et al., 2004; Chang et al., 2008; Onut et al., 2011; Sanchez et al., 2011; Ahn et al., 2014; Gohomene et al., 2016) |
| 7.b Simplicity of free trade policies and arrangement | | Straightforward and explicit tax regulations, tariff collection and import/export restrictions (Wang et al., 2011b) |
| 7.c Stability of government policies | | Consistency and dependability of government trade regulations (Wang & Hong, 2011a; Gohomene et al., 2016) |
| 8. Legal & financial service | 8.a Finance, banking and insurance services | Availability, open, and quality of financial services to facilitate seamless transfer of cargo possession (Wang et al., 2011b) |
| 8.b Legal system | | Accessibility to effective resolution and arbitration judicial services (Wang & Hong, 2011a) |

4.2. The consensus of logistics stakeholders

As to obtain the collective views of logistics stakeholders, we interview a number of experienced practitioners individually by using the questionnaire, and determine their preference for a transshipment hub. The individual judgments from these practitioners are then examined and aggregated.

**Determining individual preferences.** The experienced practitioners are identified from logistics organizations as Hong Kong Association of Freight Forwarding and Logistics Limited (HKAFF) and The Hong Kong Shippers’ Council (HKSC). Some renowned stakeholders are also asked to recommend other experienced practitioners to fill out the questionnaire. Four to five respondents are invited from each identified group to provide a broad breadth and depth of understanding from the industry. They are individually invited to assess the importance of the factors based on their views and experience. Only practitioners who are not involved in brainstorming sessions are invited to the interviews.

In each interview, 5–10 min are spent to introduce the project objectives, and the respondents complete the questionnaire usually within 45 min. Each practitioner conducts the pairwise comparison in a 9-point scale which indicates the relative importance of each factor as well as each attribute. As a result, a total of 33 industrial practitioners, including shippers, 3PLs-air, or 3PLs-sea from Hong Kong and Taiwan, are invited.

The practitioner’s individual judgment on pairwise comparisons is examined in terms of the consistence. The consistence test is to detect the level of inconsistency of the answers (i.e. the relative importance among the factors). For example, a respondent may rate Factor A more important than Factor B, and rate Factor B more important over Factor C. Therefore, Factor A should be more important than Factor C from this respondent’s perspective. However, in the pairwise comparison between Factor A and Factor C, the respondent may reflect that Factor C appears to be more important than Factor A. As such, inconsistency happens. Moreover, inconsistency may also happen due to the incorporation of 9-scale points in the survey. For example, if an respondent put an answer that Factor A is more important than Factor B at “3” (i.e. moderately important), and Factor B is more important than Factor C at “9” (i.e. extremely important), and Factor C is less important than Factor A at “2” (i.e. moderately important), then inconsistency happens again in terms of scale points.

**Table 3** shows the results of consistence tests of individual judgments. To deal with inconsistent adjustments, researchers could request interviewees to change their entry iteratively until interviewees’ judgments are near consistent (Saaty, 2003). In our study, each interviewee has to complete 9 pairwise comparison matrices. The current interview lasts for 50–55 min, with the first 5–10 min to introduce the project and the remaining 45 min to complete the questionnaire. If we perform to correct inconsistent weights, the iterative change would substantially extend the interview time.
Moreover, it may create survey fatigue, i.e., interviewees may feel bored, tired or uninterested in the survey and begin to perform less honestly. Interviewees could become arbitrary and thus distort the validity of the derived priority vector in representing the underlying decision (Saaty, 2003, page 85). Therefore, to make the interview manageable and to ensure the quality of the judgments, we exclude the practitioners whose individual responses fail in consistence tests (i.e., the consistence level is higher than 0.1) from our AHP analysis. As a result, 25 out of 33 respondents are included in this study.

Representative group judgments. Representative group judgments are obtained by aggregating the individual judgments of respondents within the same group. Individual practitioners in a category typically have some similar concerns in selecting a transshipment hub. Aggregating individual judgments is generally a proper way to represent the common concerns of the identified group. Certain computation techniques are used, such as calculating the geometric average of respective pairwise comparison weights of all the respondents, in order to obtain the overall rating on each factor and attribute collected from each group.

The geometric mean of the respective weights collected from each group is calculated to determine its representative judgment. The relatively importance of the factors for each group is then determined as shown row-wise in Table 4. Here the top three factors are identified as cost of route, customs regulations & government policies, and connectivity, which indicating these are most important for logistics stakeholders, while the other factors, such as location, port service, and legal & financial service, are considered as less important.

In fact, all stakeholders consider cost of route as one of the most important factors. This is understandable since transportation and logistics are considerably cost-driven. Besides, customs regulations & government policies is also consistently important for all respondents. Under the Direct Transportation Link policy, Hong Kong 3PLs and shippers often worry more about the documentation issues, while Taiwan 3PLs and shippers concerns about customs clearance procedures. Furthermore, connectivity is another concern, which indicates that choices of routes and connection between ports are also critical in selecting a transshipment hub.

Next, we further investigate the sub-factors identified for the three factors. Table 5 shows the top 4 sub-factors that are the most important from the perspectives of each group of logistics stakeholders.

(1) Sub-factors on cost of route. It is well observed that total costs are more important than variety of service offerings with costs to all stakeholders. Both logistics providers and shippers are concerned about the total costs that may incur but not the variety of service offerings that may offer.

(2) Sub-factors on customs regulations & government policies. Further into the attributes of customs regulations and government policies, stakeholders are concerned more about the attributes on simplicity and transparency of customs procedures and stability of government policies instead of simplicity of free trade policies. As to the cargo logistics within Great China, customs procedures and government policies are not clearly defined and often with uncertainties to most stakeholders. Additional time and extra costs may be incurred as a result to 3PLs and shippers.

With well-developed government regulations and policies, Hong Kong stakeholders concern more about the documentation issues and supports in sea freight transportation. While Taiwan 3PLs and shippers bring forth customs clearance procedures concerns—the complexity of existing customs regulations and government policies hinders rather than facilitates efficient transport logistics. If Taiwan government could provide a more open and supportive regulatory infrastructure, Taiwan could gain much more competitiveness in operating a transshipment hub.

(3) Sub-factors on connectivity. In terms of connectivity, most practitioners argue that the attribute frequency of calling vessels/flight is more important than connection to major ports. The reason is that the frequency and reliability of services are more crucial to stakeholders, while connections to major ports are rather fixed and the process to develop a new connection with other ports usually requires long negotiation.

In sum, the AHP analysis indicates the consensus and the diversity of the decisions made among the different groups on port selection. Different factors that may influence the selection of a transshipment hub are identified and investigated. The analysis shows that all stakeholders, who may be influenced by the imminent DTL, are considerably concerned about the three Cs, i.e. cost of route, customs regulations & government policies, and connectivity.

4.3. The diversity among logistics stakeholders

In addition to the three Cs, we attempt to reveal whether Hong Kong has sustained its competitive advantages in operating an international transshipment hub or if Taiwan has the potentials to overtake Hong Kong dominating position or simply replacing Hong Kong’s role as a whole. We study the logistics stakeholders’ preference on Hong Kong and Taiwan ports in general, and in effect

| Region | Logistics stakeholder | Number of respondents | Number of respondents whose individual judgments pass consistence test |
|--------|----------------------|-----------------------|---------------------------------------------------------------|
| Hong Kong | 3PLs-air | 6 | 4 |
| | 3PLs-sea | 4 | 4 |
| | Shippers | 4 | 4 |
| | Total | 12 |
| Taiwan | 3PLs-air | 5 | 4 |
| | 3PLs-sea | 7 | 4 |
| | Shippers | 7 | 5 |
| | Total | 13 |
| Both regions | 3PLs-air | 11 | 8 |
| | 3PLs-sea | 11 | 8 |
| | Shippers | 11 | 9 |
| | Total | 25 |

Table 3

Results of consistence tests of individual judgments.

| 1. Location | 2. Cost of route | 3. Facility | 4. Connectivity | 5. Port service | 6. Cargo information | 7. Customs regulations & government policies | 8. Legal & financial service |
|-------------|------------------|-------------|-----------------|-----------------|---------------------|---------------------------------------------|-----------------------------|
| HK 3PLs-air | 0.030            | 0.209 (2)   | 0.083           | 0.236 (1)       | 0.082               | 0.089                        | 0.143 (3)                    | 0.128                       |
| HK 3PLs-sea | 0.058            | 0.239 (1)   | 0.088           | 0.204 (2)       | 0.079               | 0.099                        | 0.162 (3)                    | 0.071                       |
| HK shipper  | 0.054            | 0.290 (1)   | 0.052           | 0.089           | 0.082               | 0.061                        | 0.248 (2)                    | 0.123 (3)                   |
| TW 3PLs-air | 0.053            | 0.232 (1)   | 0.044           | 0.116           | 0.140 (3)           | 0.138                        | 0.195 (2)                    | 0.082                       |
| TW 3PLs-sea | 0.054            | 0.201 (2)   | 0.083           | 0.084           | 0.097               | 0.060                        | 0.209 (1)                    | 0.122 (3)                   |
| TW shipper  | 0.172 (2)        | 0.218 (1)   | 0.087           | 0.094           | 0.112               | 0.090                        | 0.127 (3)                    | 0.100                       |

(Number) the ranking of the factors row-wise.
to understand the competitiveness of these two ports. Comments from the stakeholders are also collected and investigated.

We invite industrial practitioners to rate their preference in using Hong Kong and Taiwan ports based on their experience. The overall rating as well as the factors and attributes identified earlier are assessed on a scale of 0–10 (the higher rate, the better performance). After conducting the questionnaire, the geometric mean of the ratings is calculated to evaluate the preference of the two ports from the respective groups.

Amongst all the stakeholders, Hong Kong port has the highest rating score as shown in Table 6. It is interesting to find that the stakeholders from the respective region tend to rate higher on their corresponding ports. As to all the Hong Kong logistics stakeholders, the gap between Hong Kong port to Taiwan port is larger than 1.367. It is understandable that uncertainties may exist in a port that is unfamiliar to the practitioners. It is also observed that the competitive advantage of Hong Kong port over Taiwan port in sea freight forwarding is not as significant as that in air freight forwarding.

We further investigate the competitive advantage of the two ports with respect to the major factors three C’s in the AHP analysis (Table 7). Customs regulations and government policies, and connectivity of Hong Kong port are rated higher than that of Taiwan ports, and the gap of these two criteria between Hong Kong port and Taiwan port is relatively large. Stakeholders are satisfied with the infrastructure and the connections in Hong Kong. Hong Kong still has the advantage due to frequent connections and a wider coverage; along with its well-developed customs regulations and government policies. While cost of route in Hong Kong is rated slightly higher than the one in Taiwan, most stakeholders are willing to pay more for the quality services. From these results, it is also interesting that sea freight forwarders in both Hong Kong and Taiwan are most concerned of the costs in the logistics practices as their profit margin is relatively low compared with other stakeholders.

5. Discussions

5.1. Perspectives of shippers and freight forwarders

From the preliminary survey and interviews conducted among the sampled stakeholders, the most important factors which affect the stakeholders in selecting the transshipment hub have been identified: cost of route, customs regulations & government policies, connectivity. It has been recognized that the most obvious decision-making style among all the shippers and freight forwarders is cost-driven.

Moreover, in terms of customs regulations & government policies, many shippers and 3PLs are still adjusting themselves in the adoption of the policy. They find it difficult in execution which possibly due to natural factor or government policies including customs regulations. For instance, after the implementation of Direct Transportation Link policy, the stakeholder’s key concerns are also driven by connectivity of ports and business relationships with cargo owners, with emphasis on further clarification of government policy across the Straits and further development on the link agreement in specific terms such as taxation.

However, in terms of the other critical factors, stakeholders usually have different preferences, which mainly due to their different domain (sea/air transport) and country of origin of their company. Therefore, there is a need for decision makers to consider the options of sea/air transports and the country of origin issues during the port selection process.

Table 5
The rankings of relative importance weights of the critical sub-factors of representative group judgments. The bold is just to highlight the result.

| 1a Geographical | 2a Total costs | 2b Variety of service offering with costs | 4a Connection to major ports | 4b Frequency of calling vessels/flight | 6a Cargo info. & accessibility | 7a Simplicity & transparency of customs procedure | 7c Stability of government policies | 8a Finance services | 8b Legal system |
|-----------------|---------------|------------------------------------------|-----------------------------|--------------------------------------|-------------------------------|---------------------------------|------------------------|--------------------|------------------|
| HK air 3PLs     | 0.011         | 0.142 (2)                               | 0.067                       | 0.080 (4)                            | 0.156 (1)                    | 0.063                           | 0.031                  | 0.078               | 0.032            | 0.096 (3)       |
| HK sea 3PLs     | 0.022         | 0.163 (1)                               | 0.076 (3)                   | 0.046                                | 0.158 (2)                    | 0.044                           | 0.062 (4)              | 0.052               | 0.029            | 0.041           |
| HK shippers     | 0.024         | 0.232 (1)                               | 0.059                       | 0.028                                | 0.062                        | 0.036                           | 0.091 (3)              | 0.113 (2)           | 0.060 (4)        | 0.055           |
| TW air 3PLs     | 0.010         | 0.147 (1)                               | 0.086 (4)                   | 0.047                                | 0.099 (2)                    | 0.089 (3)                       | 0.048                  | 0.059               | 0.022            |                |
| TW sea 3PLs     | 0.014         | 0.131 (1)                               | 0.070                       | 0.023                                | 0.062                        | 0.016                           | 0.099 (3)              | 0.122 (2)           | 0.079 (4)        | 0.043           |
| TW shippers     | 0.104 (2)     | 0.132 (1)                               | 0.086 (3)                   | 0.035                                | 0.058 (4)                    | 0.043                           | 0.056                  | 0.049               | 0.047            | 0.053           |

Table 6
Overall ratings for Hong Kong and Taiwan ports.

|                  | Hong Kong Port (HK) | Taiwan Port (TW) | Gap (HK-TW) |
|------------------|---------------------|------------------|-------------|
| HK air 3PLs      | 8.958               | 7.289            | 1.669       |
| HK sea 3PLs      | 7.112               | 5.552            | 1.560       |
| HK shippers      | 8.315               | 6.136            | 2.179       |
| TW air 3PLs      | 8.146               | 7.039            | 1.107       |
| TW sea 3PLs      | 7.646               | 7.013            | 0.633       |
| TW shippers      | 7.771               | 6.716            | 1.055       |
| Average          | 7.991               | 6.624            | 1.367       |

Table 7
Competitive advantages of Hong Kong and Taiwan ports with respect to the three C’s factors.

| 2. Cost of route          | 4. Connectivity          | 7. Customs regulations & government policies |
|---------------------------|--------------------------|-----------------------------------------------|
|                           | HK port                  | TW port                                       | HK port                  | TW port                  | HK port                  | TW port                  |
| HK air 3PLs               | 8.750                    | 7.250                                         | 9.375                    | 7.000                    | 9.083                    | 6.917                    |
| HK sea 3PLs               | 5.125                    | 5.500                                         | 7.375                    | 5.125                    | 8.250                    | 5.667                    |
| HK shippers               | 6.500                    | 5.500                                         | 8.875                    | 5.875                    | 9.500                    | 6.056                    |
| TW air 3PLs               | 7.625                    | 6.875                                         | 8.750                    | 6.000                    | 8.500                    | 7.750                    |
| TW sea 3PLs               | 6.000                    | 7.625                                         | 8.250                    | 6.250                    | 8.333                    | 7.333                    |
| TW shippers               | 6.500                    | 6.000                                         | 8.500                    | 7.000                    | 8.000                    | 7.583                    |
| Average                   | 6.750                    | 6.458                                         | 8.521                    | 6.208                    | 8.611                    | 6.884                    |
| Gap                       | Small                    | Very large                                    | Large                    |                          |                           |                          |
5.2. Sea and air transports on a transshipment hub

The findings on how sea and air transports affect the selection are consistent with the critical decision factors and the relative sub-factors that identified in the brainstorm sessions. The issue of routes and connection has significant influence on the sea/air transport options. The frequency of calling vessels/aircraft and reliability of services are more crucial to stakeholders. For example, the DTL policy has brought sound benefits to the cross-strait transportation services, such as shortened traveling time due to direct flights and vessels. For air freight, travelling time from Taoyuan airport in Taiwan to Shanghai airport in Mainland China has been reduced from 6–7h to 84min while the average transport time has been decreased by 16–27h for sea freight. The policy enables 3PLs to offer more choices on selecting ports and routes between the Mainland and Taiwan to their clients.

Meanwhile, there are still barriers and difficulties that affect stakeholder’s sea/air transport selection, such as government planning, operational policy & regulations, customs issues, and stakeholder’s adoption of the policies, etc. Take DTL case as an example, Hong Kong government has been focusing on airport expansion, but paying less attention to that of seaports such as policy development with respect to DTL. As the seaports in Mainland China have been gradually developed with advanced technologies and facilities, the seaports in Hong Kong have yet to show similar driving force to maintain its leading role and competitiveness. Such lack of development progress would incur incompatibilities and handicaps for 3PLs and shippers to make full use of the policy. Taiwan, on the other hand, ports have been unattractive possibly due to unstable climate especially in typhoon seasons, which could incur higher operation costs such as delays in cargo delivery. This could result in lower motivation for the 3PLs and shipping lines to use Taiwan ports. Indeed, comparatively inefficient facilities and less transparent cargo information lead to inconvenience to operators and 3PLs for cargo handling. The operators and 3PLs are reluctant to use Taiwan ports as they often are not responsive to operational and handling changes.

5.3. Influence of country of origin of a company

In this paper, the case study provides an insight into how the stakeholder’s country of origin influences their preferences in port selection process. The survey result shows that stakeholders tend to choose their own country’s port, given that they have concrete knowledge of their own country or region’s competitive advantages and clear understanding of the policies and regulations.

For example, in the case study, Hong Kong logistics stakeholders have been recognized that they tend to choose Hong Kong as their sea/air transport, mainly due to their better understanding of the simple customs procedures and the free-trade gateway. They also have sufficient know-how to leverage Hong Kong port’s undisputed advantages on high handling efficiency, close connection with major ports around the world, and well-established infrastructure with open legal and financial system, which provides a fair and transparent market to all business parties.

Meanwhile Taiwanese shippers and 3PLs forwarders tend to choose Taiwan as their logistics ports, given that the natural geographical advantage of Taiwan Strait which could offer close connection with the coastal seaports in the Mainland. Besides, Taiwan has its own national carriers that offer more control in routing cargo between Taiwan port and major ports in Mainland China. However, in light of global logistics, the logistics stakeholders should take the initiative to learn and adopt new policies, and push development of transshipment hubs. On the other hand, in order to attract more business opportunities, governments should provide a fair and transparent market with open legal and financial system to enhance the competitive advantages of their logistics ports. Thus, all business parties will embrace the new business models and benefit from it.

6. Conclusion

This study has sought to identify critical factors in selecting a transshipment hub, highlighting the assessment from the perspectives of shippers and freight forwarders, with the options of both sea and air transports, and from the influence of logistics stakeholder’s country of origin. Relative importance of the key factors in transshipment hub selection is assessed by applying an AHP method to a sample of logistic stakeholders. The Direct Transportation Link policy in China is studied and its implementation is used as a backdrop case of global logistics strategy involving the role of transshipment hub in reliability and profitability. The policy change creates a significant research opportunity to build an understanding of threats as a result that can be viewed, processed and aligned strategically if necessary.

In our research findings, the cost of route, customs regulations & government policies, and connectivity are significantly important in transshipment hub selection across logistics service providers and cargo owners. These service providers, of both sea and air, view effective control over route planning is sound business strategy to service their clients. Moreover, the findings suggest that the competitiveness of a transshipment hub may not diminish with the span of other nearby ports, even if these ports offer obvious shorter transport distance and are within closer proximity to cargo sources.

It is also noted that uncertainties manifested by other explicit advantageous ports could translate to barriers such as uncontrollable delays and/or additional new costs to move forward, effectively hindering on the building of client satisfaction. Last but not least, governments must heed in their effort to facilitate one-stop hub services that improvement to the existing infrastructure and simplification of related regulations are two important factors.

Logistics stakeholders, especially local contributors of the economy, could benefit from our findings as they can evaluate the business opportunities of ports accordingly and properly align to corporate strategy within. In future, more cross-sectional studies are needed in terms of alternative benefits of intermodal freight transport across all logistics stakeholders over different competing regions. It is also worthwhile to perform longitudinal studies to investigate the change of noted factors over an extended period of time.

Acknowledgments

This work was supported by Hong Kong Logistics Development Council, Centre of Cyber Logistics of the Chinese University of Hong Kong, and the National Natural Science Foundation of China (grant no. 71271222).

References

Ahn, W.-C., Lee, C.-H., & Han, J.-K. (2014). A study on the securement of the competitiveness of Gyeyong-In Port. Asian Journal of Shipping and Logistics, 30(2), 243–264.
Alonso, L. G., & Sanchez-Soriano, J. (2009). Port selection from a hinterland perspective. Maritime Economics & Logistics, 11, 260–269.
Baird, A. J. (2006). Optimising the container transhipment hub location in northern Europe. Journal of Transport Geography, 14(3), 195–214.
Brun, A., Caniafo, F., Caridi, M., Castelli, C., Miragliotta, G., Ronchi, S., et al. (2008). Logistics and supply chain management in luxury fashion retail: Empirical investigation of Italian firms. International Journal of Production Economics, 114, 558–570.
Carlan, V., Sys, C., & Vaneltslander, T. (2016). How port community systems can contribute to port competitiveness: Developing a cost-benefit framework. Research in Transportation Business & Management, 19, 51–64.
Chang, Y. T., Lee, S. Y., & Tongzon, J. L. (2008). Port selection factors by shipping lines: Different perspectives between trunk liners and feeder service providers. Marine Policy, 32(6), 877–885.

Chou, C. C. (2007). A fuzzy MCDM method for solving marine transshipment container port selection problems. Applied Mathematics & Computation, 186(1), 435–444.

Chu, H.-C. (2014). Exploring preference heterogeneity of air freight forwarders in the choices of carriers and routes. Journal of Air Transport Management, 37, 45–52.

Demirbag, M., Tatoglu, E., Glaister, K. W., & Zaim, S. (2010). Measuring strategic decision making efficiency in different country contexts: A comparison of British and Turkish firms. Omega, 38, 95–104.

Di Gravio, G., Patricarca, R., Mancini, M., & Costantino, F. (2016). Overall safety performance of the air traffic management system: The Italian ANSP’s experience on APE. Research in Transportation Business and Management, 20, 3–12.

Du, Q., Kim, A. M., & Zheng, Y. (2017). Modeling multimodal freight transportation scenarios in Northern Canada under climate change impacts. Research in Transportation Business & Management. http://dx.doi.org/10.1016/j.rtbm.2017.02.002. 11 pages.

Golbrom, D. A., Yang, Z. L., Bonsal, S., Mastralis, E., Wang, J., & Li, K. X. (2016). The attractiveness of ports in West Africa: Some lessons from shipping lines’ port selection. Growth and Change, 47(1), 416–426.

Guy, E., & Utl, B. (2006). Port selection and multicriteria analysis: An application to the Montreal-New York alternative. Maritime Economics & Logistics, 8, 169–186.

Harzing, A.-W., & Sorge, A. (2003). The relative impact of country of origin and universal contingencies on internationalization strategies and corporate control in multinational enterprises: Worldwide and European perspectives. Organization Studies, 24(2), 187–214.

Hughes, W. R. (2009). A statistical framework for strategic decision making with AHP: Probability assessment and Bayesian revision. Omega, 37(2), 463–470.

Insch, G. S., & McBride, J. B. (2004). The impact of country-of-origin cues on consumer perceptions of product quality: A binatorial test of the decomposed country-of-origin construct. Journal of Business Research, 57, 256–265.

Jiang, X., Lee, H. L., Chew, E. P., Han, Y., & Tan, K. C. (2012). A container yard storage strategy for improving land utilization and operation efficiency in a transshipment hub port. European Journal of Operational Research, 221(1), 64–73.

Johnson, C. R. (1980). Constructive critique of a hierarchical prioritization scheme employing paired comparisons. In Proceedings of the International Conference of Cybernetics and Society of the IEEE (pp. 373–378). Institute of Electrical Engineers.

Kulisic, E. (2016). Crowley gets green light for sea-air transshipment in Miami. American Shipper - News October 19, 2016, www.americanshipper.com/main/news/crowley-gets-green-light-for-sea-air-transshipment-65749.aspx. Accessed 10.03.17.

Linn, T. C., Thanapoulou, H. A., & Beresford, A. K. C. (2003). Transshipment port selection and decision-making behaviour: Analysing the Taiwanese case. International Journal of Logistics – Research and Applications, 6(4), 229–244.

Linn, T. C., Thanapoulou, H. A., Beynon, M. J., & Beresford, A. K. C. (2004). An application of AHP on transshipment port selection: A global perspective. Maritime Economics & Logistics, 6, 70–91.

Low, J. M. W., Yuan, X. M., & Tang, L. C. (2008). Performance linkages between an airport and the air cargo supply chain – Evidences from Hong Kong and Singapore. In The IEEE International Conference on Industrial Informatics (pp. 1722–1728).

Malchow, M. B., & Kanafani, A. (2004). A disaggregate analysis of port selection. Transportation Research Part E, 40(4), 317–337.

Meersman, H., de Voorde, E. V., & Vanelslander, T. (2016). Port competitiveness now and in the future: What are the issues and challenges? Research in Transportation Business & Management, 19, 1–13.

Nir, A. S., Lin, K. R., & Liang, G. S. (2003). Port choice behavior – From the perspective of the shipper. Maritime Policy & Management, 30(2), 165–173.

Nugroho, M. T., Whiteing, A., & de Jong, G. (2016). Port and inland mode choice from the exporters’ and forwarders’ perspectives: Case study – Java, Indonesia. Research in Transportation Business & Management, 19, 73–82.

Onut, S., Tuzkaya, U. R., & Torun, E. (2011). Selecting container port via a fuzzy ANP-based approach: A case study in the Marmara Region Turkey. Transport Policy, 18(1), 182–193.

Petering, M. E. H., & Mutry, K. G. (2009). Effect of block length and yard crane deployment systems on overall performance at a seaport container transshipment terminal. Computers & Operations Research, 36(5), 1711–1725.

Ramanathan, U. (2013). Aligning supply chain collaboration using analytic hierarchy process. Omega, 41, 431–440.

Saaty, T. L. (1980). The analytic hierarchy process: Planning, priority setting, resource allocation. McGraw-Hill.

Saaty, T. L. (1990). How to make a decision: The analytic hierarchy process. European Journal of Operational Research, 48(1), 9–26.

Saaty, T. L. (2003). Decision-making with the AHP: Why is the principal eigenvector necessary. European Journal of Operational Research, 145(1), 85–91.

Sánchez, R. J., Ng, A. K. Y., & García- Alonso, L. (2011). Port selection factors and attractiveness: The service providers’ perspective. Transportation Journal, 55(2), 141–161.

Sayehri, J., & Alizimini, H. R. (2014). A hybrid decision-making model for selecting container seaport in the Persian Gulf. Asian Journal of Shipping and Logistics, 30(1), 75–95.

Shi, X., & Li, H. (2016). Developing the port hinterland: Different perspectives and their application to Shenzhen Port, China. Research in Transportation Business & Management, 19, 92–105.

Song, D. W., & Yeo, K. T. (2004). A competitive analysis of Chinese container port using the analytic hierarchy process. Maritime Economics & Logistics, 6, 34–52.

Song, M., Calantone, R. J., & Anthony, C. (2002). Competitive forces and strategic choice decisions: An experimental investigation in the United States and Japan. Strategic Management Journal, 23, 969–978.

Steven, A. B., & Corsi, T. M. (2012). Choosing a port: An analysis of containerized imports into the US. Transportation Research Part E: Logistics and Transportation Review, 48(4), 881–895.

Talley, W. K., & Ng, M. W. (2013). Maritime transport chain choice by carriers, ports and shippers. International Journal of Production Economics, 142(2), 311–316.

Teng, S. G., & Jaramillo, H. (2005). A model for evaluation and selection of suppliers in global textile and apparel supply chains. International Journal of Physical Distribution & Logistics Management, 35(7), 503–523.

Tongzon, J. L. (2009). Port choice and freight forwarders. Transportation Research Part E, 45(1), 186–195.

Tran, N. K. (2011). Studying port selection on liner routes: An approach from logistics perspective. Research in Transportation Economics, 32(1), 39–53.

Van Den Honert, R. C., & Lootsma, F. A. (1997). Group preference aggregation in the multiplicative AHP: The model of the group decision process and Pareto optimality. European Journal of Operational Research, 95(2), 363–370.

Van Hassel, E., Meersman, H., de Voorde, E. V., & Vanelslander, T. (2013). North–South container port competition in Europe: The effect of changing environment policy. Research in Transportation Business & Management, 9, 4–18.

Vis, I. F. A., & de Koster, R. (2003). Transshipment of containers at a container terminal: An overview. European Journal of Operational Research, 147, 1–16.

Wang, H., Wang, X., & Zhang, X. (2017). Dynamic resource allocation for intermodal freight transportation with network effects: Approximations and algorithms. Transportation Research Part B: Methodological, 99, 88–112.

Wang, K. J., & Hong, W. C. (2011a). Competitive advantage analysis and strategy formulation of airport city development – The case of Taiwan. Transport Policy, 18(1), 276–288.

Wang, K. J., Hong, W. C., Chen, S. H., & Jiang, J. T. (2011b). Strategic development trend and key factors analysis of airport city in Taiwan. Journal of Transportation Geography, 19(4), 807–820.

Wang, X., & Meng, Q. (2017). Discrete intermodal freight transportation network design with route choice behavior of intermodal operators. Transportation Research Part B: Methodological, 55, 76–104.

Wang, Y., Jung, K.-A., Yeo, G.-T., & Chou, C.-C. (2014). Selecting a cruise port of call location using the fuzzy-AHP method: A case study in East Asia. Tourism Management, 42, 262–270.

Yang, Y. H., Hui, Y. V., Leung, L. C., & Chen, G. (2010). An analytic network process approach to the selection of logistics service providers for air cargo. Journal of Operational Research Society, 61(9), 1365–1376.

Zahedi, F. (1986). The analytic hierarchy process—A survey of the method and its applications. Interfaces, 16(4), 96–108.