A STUDY OF THE ATTRACTIVENESS OF AIRLINE CARGO SERVICE INFLUENCING FREIGHT FORWARDERS' CHOICE

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Introduction

With the new era of digital globalization, the air cargo industry has continued to function as a key architect of world trade and has doubled in volume every years. For Air cargo, according to Boeing (2017), the demand increased a modest 1.9 percent in 2015. Air cargo traffic will progressively speed up in 2016 and 2017 and will remain in long-term trend growth in 2018. Boeing (2017) also indicated that world air cargo traffic is forecasted to grow with an average of 4.2 percent per year over the next 20-30 years as shown in Figure 1. Overall, world air cargo traffic will grow from 223 billion RTKs in 2015 to 509 billion RTKs in the year 2035. Domestic China and Intra-Asia are ranked first in term of air cargo growth, with 6.2% growth

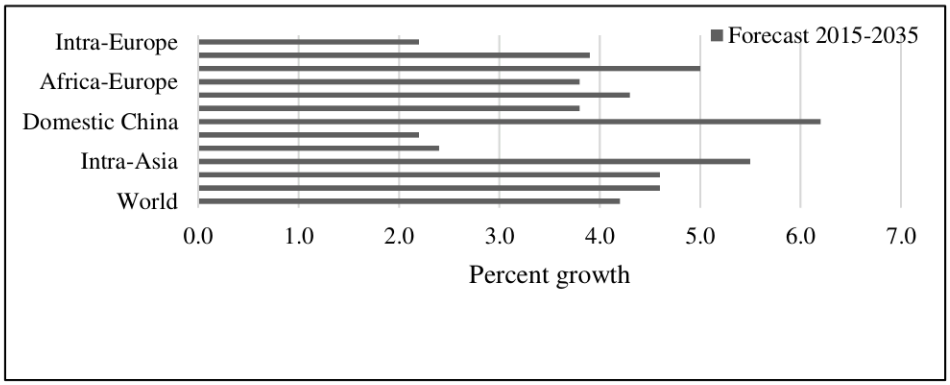

Figure 1: World air cargo traffic forecast by a percentage
Source: Organized by Author; (Boeing, 2017)

Air cargo transport involves a series of services from origins to destinations to move cargo through a shipper, a forwarder, a road transporter (or trucker), an airline (or carrier), and a consignee (Derigs et al., 2009). The shipper requests the commodity to be sent at a low cost and at the required service level. The forwarder performs as the ‘‘middle man’’ between the shipper and the airlines. The road transporter provides the ground transportation services before and after air transport. The airline receives, stores, transfers, tracks, loads and unloads cargo, and assigns and manages capacity. The consignee receives the shipment (Kasilingam, 2003) as present in figure 2.

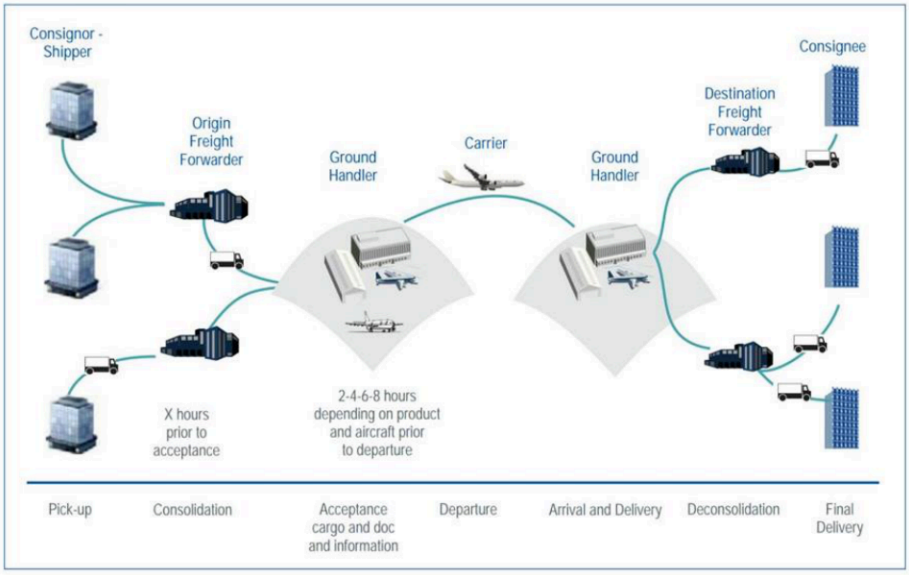

Figure 2: Physical Handling Flow (IATA, 2017)

Airlines are challenged to manage air cargo operations resourcefully by emerging strategic operation plans that allow these airlines to quickly adapt and respond to changes in the global competitive environment (Nobert and Roy, 1998; Ferguson et al., 2013). In order to react to such challenges, an increasing amount of research has been showed to address the problems in air cargo operations. Nevertheless, most problems, real-world problems in particular, keep on unsatisfactorily solved, relatively because of the complexities of air cargo operations. Therefore, this study aims to present the challenges faced by the airline cargo transport industry which is the perspective of freight forwarders that effect to the choice of airline cargo.

The rest of this paper is organized as follows. Section 2 describes the literature review for air cargo transport and the freight forwarder's perspective. Section 3 highlights the case study of Thailand. Section 4 presents the summary.

Literature Review

For the literature review, this study consider two perspectives which are air freight forwarder's perspective and factors selection process.

The freight forwarder's perspective

The majority of extant literature focuses on the air cargo operations of airlines, and only a few discuss those of freight forwarders. Xue and Lai (1997) presented an integer programming model for container selection and cargo loading to minimize the total cost. Chew et al. (2006) suggested a stochastic dynamic programming model for the short-term capacity planning of the freight forwarder; the model was used to define the additional short-term capacity. While container loading segments many similarities with aircraft loading, such as the need to consider volume and weight, container loading has some unique characteristics. Chan et al. (2006) developed a decision support system to optimize the cost related to air cargo pallet selection and loading. Huang and Chi (2007) studied how a freight forwarder should consolidate its shipments to utilize the quantity discounts offered by airlines. Wu (2008) built an optimization model to help logistics managers make decisions on how to rent containers from airlines with different weight and volume limits. Li et al. (2009) discussed research issue and developed a large-scale neighborhood search heuristic to determine the container loading plan. Wu (2010) extended his 2008 study to an uncertain environment and formulated a stochastic mixed 0–1 integer model to determine the booking types and quantities of containers, as well as a containerization plan to minimize the total rental cost. Wu (2011) further extended his research to incorporate the decision of renting and returning the number of containers by using a two-stage recourse model with allowance of later transport. Tang (2011) developed a scenario decomposition-genetic algorithm to solve the pure

and mixed container loading problem. Chan et al. (2012) developed a multi-agent-based system based on the cargo information obtained by radio-frequency identification (RFID) technology to assist freight forwarders in flight planning.

The literature has only focused the problem of market demand estimation and capacity booking when consider the freight forwarder perspective. The freight forwarder forecasts demand by integrating factors, such as trend, seasonality, and ad-hoc events. Then, the forwarder allocates capacity from several airlines and from the long-term contract and the spot market to maximize the expected profit under demand uncertainty and market prices, subject to transport budgets, departure time (e.g., morning or night flight), service priority, and capacity allocation from the airlines. However, as freight forwarders have to select airline to deliver the cargo, it has to be the significant factors which affected to the freight forwarder selection. This study focus on those factors which give the opportunities for airlines in order to improve their services.

Factors selection method

Location selection among a set of alternatives along with numerous contradictory criteria is a multiple criteria decision making (MCDM) problem. The objective of this research is to select the most appropriate location among alternatives for a regional aviation hub in the Northern part of Thailand. MCDM methods support decision makers solve complex decision problems involving conflicting criteria in a systematic and consistent way. Mardani, Zavadskas, Khalifah, Jusoh, and Nor (2016) show that use of MCDM methods has significant growth in the field of transportation systems.

MCDM includes many methods such as AHP, TOPSIS, PROMETHEE, SAW, and the newest method - Best-Worst Methods. Between these methods, only TOPSIS and AHP were found to be used most in air transport study. Marvelous efforts have been consumed and noteworthy advances have been completed towards the development of several MCDM methods for solving different types of decision problems (Yeh, Deng, and Pan (1999); Triantaphyllou (2000). In spite of this, there is no generally accepted approach for the general MCDM problem (Yeh, Deng, & Chang, 2000), and the proof of the decision outcome remains generally an open issue. The outcome is quite regularly reliant on the method used.

There are many ways and methods to evaluate location selection. Therefore, to select the suitable method, it is depends on the research objective and data collection. This research utilizes two MCDM methods, Best-Worst Method to define the weights of criteria and VIKOR to rank alternatives and select the best alternative. Best-Worst Method (which is developed based on AHP model) is used to define the weights in the hierarchy of criteria. VIKOR as a compromise ranking method are used for ranking and selection process in order to be assured in selecting the best alternative. Another reason for using these methods is their successful applications to the MCDM problems in the literature.

Best-Worst Method is the latest MCDM technique proposed by Rezaei (2015), which is based on pairwise comparisons to acquire the weights of alternatives and criteria respective to several criteria. It reduces the number of pairwise comparison by only executing reference comparison which means that experts are only required to define the preference of best criterion over other criteria and the preference of all criteria over the worst criterion, using on a 1-9 scale. By removing secondary comparisons this method is much more efficient and easier to obtain weights in an MCDM problem. This method had been used in a variety of contexts such as supplier selection (Rezaei, Nispeling, Sarkis, & Tavasszy, 2016), sustainable supply chain (Sadaghiani, Ahmad, Rezaei, & Tavasszy, 2015), energy efficiency of buildings (Parmarth Gupta, Anand, & Gupta, 2017), urban sewage treatment technologies sustainability assessment (Ren, Liang, & Chan, 2017), and measuring university-industry PhD projects efficiency (Salimi & Rezaei, 2016).

The literature on VIKOR and Fuzzy VIKOR methods is reviewed by Yazdani and Graeml (2014) for a total of 198 papers with 9 main application areas from 2002 to 2014, by Gul, Celik, Aydin, Gumus, and Guneri (2016) for a total of 343 papers with 13 main application areas from 1998 to 2015 and by Mardani, Zavadskas, Govindan, Amat Senin, and Jusoh (2016) for a total of 176 papers with 15 main application areas from 2004 to 2015. Uludag and Deveci (2013) applied Fuzzy VIKOR and Fuzzy TOPSIS methods to a potential city airport location selection problem by assessing thirty-four sub-criteria under nine main criteria (geographical specifications, climatic conditions, infrastructure conditions, costs,

transportation, the possibility of extension, legal restrictions and regulations, potential demand, environmental and social effects) for five location alternatives. Milosevic and Naunovic (2013) adopted VIKOR for determining the most suitable location for a sanitary landfill facility from three alternatives by evaluating thirty-two sub-criteria under five main criteria (hydrogeological criteria, meteorological criteria, spatial criteria, socio-political criteria, and legal and economic criteria) and use fuzzy AHP for determining weighting coefficients of the evaluation criteria. Liu, You, Chen, and Fan (2014) proposed an extended VIKOR method based on the interval 2-tuple linguistic variables to select the best disposal site for municipal solid waste among four alternatives considering four criteria (adjacent land use, climate, road access, and cost). Mokhtarian, Sadi-Nezhad, and Makui (2014) proposed Interval Valued Fuzzy VIKOR as a reliable method to select a appropriate location for digging some pits for municipal wet waste landfill. Pankaj Gupta, Mehlawat, and Grover (2016) proposed an extended VIKOR method using trapezoidal intuitionistic fuzzy numbers and apply it to the plant location selection problem with six criteria (skilled workers, expansion possibility, availability of acquirement material, investment cost, transport facilities, and climate) and three location alternatives. Hariz, Dönmez, and Sennaroglu (2017) completed Geographical Information Systems (GIS) analysis to classify feasible incinerator locations based on economic, environmental and social criteria and then use AHP, VIKOR and PROMETHEE methods to select the best location for a central healthcare waste incinerator.

The information provided indicates that there has been very few studies of location selection for a freight forwarder's perspective in the journal papers, therefore, presented MCDM problem and significant factors for evaluating factors is considered as the main contribution of this research to the literature.

Methodology

Factor weighting using Best-Worst Method (BWM)

Multi-criteria decision-making (MCDM) is a significant branch of decision-making concept. As mentioned in Chapter 2, the latest MCDM method is Best-worst method was selected for this research. The step of BWM was describe below (Razaei, 2015);

Step 1: Build the set of decision criteria. In this step, the criteria ($C_1, C_2,\ldots,C_n$) that should be used are considered. This step is done by factor screening process at the very beginning of the phase. The structure of the criteria can be built as the hierarchy level as shown in Figure 3

Step 2: Select the best criteria (most important) and the worst criteria (least important). In this step, the decision-makers identify each criteria and decide the most- and least important among the criteria. There are no comparison process in this step

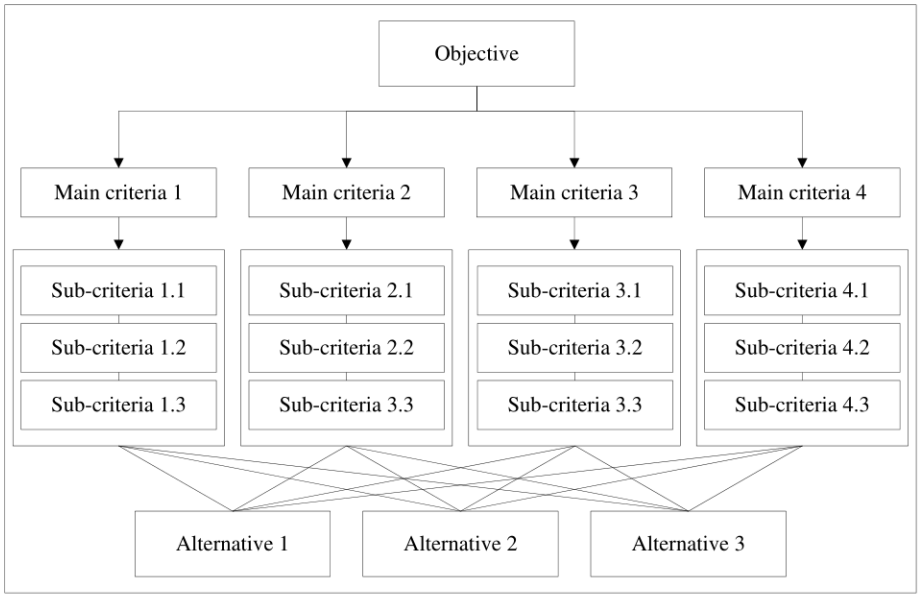

Figure 3 Criteria structure Source: Organized by Author

Step 3: Determine the preference of best criteria over all other criteria using the number between 1 and 9, as shown in Table 5.1. The value of 1,3,5,7,9 characterize equal importance, weak importance, essential importance, demonstrated importance, and extreme importance, respectively; while the value 2,4,6, and 8 are used to compromise between the values. The result of Best-to-Others vector would be:

$$A_B = (a_{B1}, a_{B2}, \dots, a_{Bn})$$

Where a_{Bj} represent the preference of the best criteria B over criterion j. It is clear that $a_{BB} = 1$

Table 1 The fundamental scale of absolute numbers

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another: its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation

Source: Saaty (2008)

Step 4: Determine the preference of all criteria over the worst criteria using the number between 1 and 9, as shown in Table 1. The result of Best-to-Others vector would be:

$$A_w = (a_{1w}, a_{2w}, \dots, a_{nw})$$

Where a_{jw} represent the preference of the criterion j over the worst criteria W. It is clear that $a_{WW} = 1$

Step 5: Find the optimal weights$(W_1^*, W_2^*, \dots, W_n^*)$. The optimal weight for the criteria is the one where, for each pair of W_B/W_j and W_j/W_w, the $W_B/W_j = a_{Bj}$ and $W_j/W_w = a_{jw}$. The next step is to satisfy these condition for all. The solution, where the maximum absolute difference $\left|\frac{W_B}{W_j} - a_{Bj}\right|$ and $\left|\frac{W_j}{W_w} - a_{jw}\right|$ for all j is minimized, should be made. Considering the non-negativity and sum condition for the weights, the following problem is resulted;

$$\begin{aligned}
&\text{Min } \xi \\
&\text{s.t.} \\
&\left|\frac{W_B}{W_j} - a_{Bj}\right| \le \xi, \text{ for all j} \\
&\left|\frac{W_j}{W_w} - a_{jw}\right| \le \xi, \text{ for all j} \\
&\textstyle\sum_j W_j = 1 \\
&W_j \ge 0, \text{ for all j}
\end{aligned} \qquad (1)$$

Solving problem (1), the optimal weights $(W_1^*, W_2^*, \dots, W_n^*)$ and ξ* are obtained.

The last step is to test the consistency through calculation, modifying it if necessary to get an acceptable consistency. Table 2 shows the order of the consistency index table according to study of Razaei, (2015) which is used to calculate Equation (2). The consistency ratio for Best-Worst Method using ξ and the corresponding consistency index, as follow;

$$\text{Consistency Ratio} = \frac{\xi^*}{Consistency\ Index} \qquad (2)$$

Table 2 Consistency Index (CI) table

a_{BW}	1	2	3	4	5	6	7	8	9
CI	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23

Source: Razaei, (2015)

Case study of Thailand

In according to shippers or freight forwarders, the decision making to select airlines to carry their shipments are several criteria regarding to mostly time to reach destinations. Besides of that, there are factors that can defeat the lead time to reach destinations performed by airline services and performance. The decision is not only by shippers or freight forwarders but also airline operation as following details:

- Destination
  The destinations served by airlines are considered significant because the shippers will ship their goods or cargo to destinations ordered by their buyers. They cannot ship their cargo to other destinations without service order. This is initially clear and important to the shippers to decide on which airlines they will select to use for carrying their cargo to their desired destinations at buyers/consignees' final destinations. The cargo must arrive the destination of consignees.

- Flying time/Distance
  The flying time and distance is another key factor that the shippers need to consider to select airlines. The preferred time and distance is certainly shorter is better to meet the lead time to

deliver cargo to consignees or buyers at their factories. The shorter flying time and distance become important and preferable factors for shippers on choices of airlines who offer shorter service to consignees. There would not be a detour operating time and distance to be accepted by shippers and consignees.

- Aircraft types and cargo space
  There are several types of aircrafts with narrow-body and wide-body aircrafts. The cargo compartment of such two types of aircrafts are different in carrying capacity. Even the same type of aircraft can also different depending on airline design of cargo belly. The shippers with small shipments with proper dimension that can fit in can consider to select narrow-body airlines to carry cargo to their destinations while the shippers with bulky or skid cargo need to consider only wide-body airlines. Not only that the shippers with skid, long, heavy and/or oversize cargo have to select airlines with sufficient and capable aircrafts to carry such odd cargo. Basically, weight and dimension of cargo must be able to load/unload into airline aircrafts. The shippers shall be aware of this condition.

- Airfreight transport fare
  The fee is one of the main criteria for shippers to choose airlines to ship their cargo. The costly offer from some airlines may make shippers to decide to use other airlines. On the other hand, low cost offer may influence shippers to move from legacy airlines to airlines with much cheaper costs as nowadays, the shipping market is highly competitive and there are thousands of airlines who compete to offer a good deal to shippers. Of course, lower costs of transport fee bring more revenue to shippers and save more expense to consignees.

- Number of transit/transfer
  In order to meet the time line to deliver cargo to consignees, some numbers of transit/transfer are acceptable but unquestionably, only limited numbers are satisfactory. There are several operational handling activities at transit/transfer airports. This means that there might be irregularities such as missing, damage or pilferage to the cargo that may not arrive in a due time or properly. This leads to unfavorable to consignees and shippers to the selected airlines.

Factor weighting using Best-Worst Method (BWM)

After conducting the experts' group discussion for factor selection process, in this step, a structured interview was applied in order for determining the weight and significance of each variable. The survey is conducted and delivered to the experts in the in the management level who came from related aviation industry such as Airports of Thailand, airline, and freight forwarders. Below are the step of the method to calculate the weight of each criteria.

Step 1: Determine a set of criteria; this step consider the criteria that should be used which already done by the group discussion. Five variables were selected for this step

Step 2: Determine the best (the most important criteria) and the worst criteria (the least important criteria); in this step, the decision makers decided the criteria without any comparison. Table 3 show the results that the most important criteria is regional plan and the least important criteria is general topographic of vicinity.

Table 3 Determine the best and worst criteria

Criteria	Rank
Airfreight transport fare	Best
Number of transit/transfer	Worst

The next step is to construct Best-Worst method to investigate the weights and priority of each variable. The analysis were made on a scale from 1 to 9. Table 4 presents the final weights of each criteria. Among the 5 criteria, the experts decided that Airfreight transport fare was the most important variable. The result show the weight of Airfreight transport fare to be 0.1815. The experts agreed that

the airfreight transport fare is main criteria for shippers to choose airlines to ship their cargo. In addition, the consistency ratio (CR) was all smaller than 0.1; therefore, the results were considered to be reliable.

Table 4 Factor weighting summary

Criteria	Weight	Rank
Airfreight transport fare	0.375	1
Number of transit/transfer	0.042	5
Destination	0.241	2
Flying time/Distance	0.157	4
Aircraft types and cargo space	0.185	3

Currently, the air freight transport business among airlines is highly competitive due to more and more airlines enter the market. Airlines now compete each other to find cargo from shippers. Most of shippers appoint freight forwarders to arrange shippers' shipments to consignees' destinations on their behalf. Then, the decision making from freight forwarders are crucial to airlines. Airlines make sales and promotion approach to the forwarders. Some of them may not know the significant criteria that the forwarders aim for. This study is to simplify airlines to understand major criteria from the forwarders to select airlines to transport their shipments.

Table 4 presents significant criteria for airlines to acknowledge the significance. Airfreight transport fare is ranked as first as nowadays, every business attempts to provide products with the lowest cost as possible to earn more yield of its products. Airfreight transport fare is one of the major costs to traders. Airlines offer the best fare to forwarders. On the other hand, forwarders now open bidding for each shipment and have airlines to bid for that business. This business trend re-emphasizes on the outcome of this research that forwarders focus on reasonable airfreight transport fare while number of transit/transfer is the least important forwarders as long as airlines carry cargo to the final destinations and meet their lead-time. There is not much influence to forwarders to select airlines. At the same service standard, airlines who offer the lowest airfreight transport fare will be selected by forwarders. In reality, airlines offer different services and standards. Pricing is the most important but still need to consider other factors as well.

There are other criteria that airlines can offer to forwarders together with pricing. Destination is also important to meet forwarders' expectation. Airlines without destinations, that forwarders wish to send cargo to, are useless. The shippers will specify destinations to deliver cargo to its customers or consignees. Therefore, the destinations are strictly identified. Other than destination, aircraft types and cargo space and flying time/distance are ranked in the middle of the result. These two criteria shall be together along with destination. As mentioned earlier, without preferred destinations by shippers, airlines will not be selected. Therefore, airlines with shippers' preferred destinations need to focus on airfreight transport fee because such airlines have the strongest point of sales for destination criteria with good transport rate. The airlines will be attractive to forwarders' choice. If the airlines even have suitable aircraft types and cargo space and flying time/distance that meet cargo requirement such as volume and dimension or lead time. Such airlines will be preferable to gain the selection by forwarders. Then, airline attractiveness will be more interesting to forwarders and considered a simple case for airlines to win the attractiveness.

However, airlines without forwarders' desired destinations are difficult to win the business at all as there is no destination. Nevertheless, airlines can find partnered airlines or trucking companies to extend their network to meet the desired destination. The partnered airlines (receiving airlines or second/third legs) shall meet the basic criteria of the transferring airlines (first leg) of destination, aircraft types and cargo space and flying time/distance. As long as pricing is right. Destination can offer. Cargo can be loaded into aircraft. The lead-time is met properly. The airlines will be choices of forwarders. Likewise, trucking companies are widely used in Europe, Australia, USA, Japan, etc. The trucker can even transport from destination airports to where airplanes cannot land. Airlines can offer forwarders to send such cargo with customs clearance service directly to consignee's factories. This would be more beneficial to shippers and consignees as one stop service for all parties. At transferring points, there

might be irregular ties occurred such as damaged, missing, pilferage cargo. This is unpleasant to forwarders at all. Still, pricing is vital to forwarders to consider with connecting points offered from airlines.

This research recommends airlines without forwarders' desired destinations to find transporting partners no matter with interline airlines or truckers to expand their network. This would bring such airlines more attractive to forwarders together with pricing and dissolve the destination criteria.

Conclusion

Even though airfreight transport fare is significant to forwarders to choose airlines for transporting their good. Other criteria are important as well to make an offer to forwarders. Airlines must consider their services to offer the completed services in order to earn more business. These five criteria shall be altogether to make a strategic approach from airlines. Without one of each, the selection will not be completed. Nowadays, forwarders prefer to have all-in service and charge as long as cargo arrive destinations without irregularity and leaving all operation works to airlines based on such five criteria examined from industrial experts and academic methodology. This research is sophisticatedly combined between actual practices and academic section to reveal significant criteria that airlines should be aware of and touch upon to all practitioners.

Reference

Can be furnished upon request.