STUDY OF AIRLINES' CARGO HUB AIRPORT SELECTION – AN EMPIRICAL STUDY IN TAIWAN

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ABSTRACT

This research employs AHP questionnaires to survey major air carriers in Taiwan, and to identify the most important service attributes and the performance of the CKS airport freight terminal, as evaluated by the major airlines serving the CKS airport, so that the core competence of the air cargo terminal can be found and employed to develop the Taoyuan international airport (CKS airport) into a major cross-continent hub airport in East Asia. Of the many service attributes that possibly influence an air carrier's cargo hub airport selection decision-making strategy in the great China region, geography of airports is perceived as the most important service attribute, followed by congestion and delay, operational availability, bilateral agreement, local demand, political risk, and airport user charge attributes. These attributes are some of the most frequently reported service attributes which influence an air carrier's hub airport's decision-making behaviour, according to previous literature. However, this report is the first to rank them using an empirical study through surveying major air cargo carriers served Taiwan.

INTRODUCTION

Taiwan's information and electronic manufacturing industry accounted for 23.6% of its manufacturing production in terms of value in 1995 (Fu, 1995). This figure grew to 36.43% in 2001, and is expected to reach 41% in 2011. Most of these information and electronic manufacturing products are heavily reliant on a good air transportation network to meet the challenges presented by rapidly changing markets (Kasarda and Green, 2003). According to the Association of Asia Pacific Airlines (AAPA, 2005), the Freight Ton Kilometre (FTK) growth rate is 18% in the Asian region: this is one of the highest growth figures in the world. A nation with a regional hub airport not only provides many job opportunities for its citizens (Button, 2002), but also increases the nation's export of information and electronic manufacturing products through high-density air route networking and frequent flight schedules. Thus, Taiwan's information and electronic manufacturing industry can seize market opportunities abroad as soon as they appear.

Currently there are four Taiwanese airlines and nineteen foreign airlines[1] providing direct air cargo services linking CKS airport in North Taiwan with 66 airports abroad[2]. According to the Association of Asia Pacific Airlines (AAPA , 2005), in the Asia Pacific region, three of the top ten air cargo origin-destination city pairs originated from or were destined for Taipei in the first half of 2005. In fact, of the top ten cargo sectors between the two cities, Taipei-Anchorage and Hong Kong-Taipei are ranked as the only two city-pairs with semi-annual cargo traffics larger than 100,000 tones. However, Hong Kong-Taiwan air cargo traffic increased by 0.8% and Taipei-Tokyo cargo traffic decreased by 15.3% in the first sixth months of 2005. A way to read the airlines' minds and to avoid a decline in air cargo traffic in CKS airport, a major air cargo hub in Taiwan, is very important, from this airport authority's viewpoint.

LITERATURE REVIEW

Gardiner et al. (2005) reviewed freighter operators' choice of hub airport through reviewing the published literature, and identified location, airport quality and third-party influences as key factors in carriers' choice of hub airports. Tretheway and Kincaid's (2005) study examined airport competition and made clear that airports can compete by utilising the "four P's of marketing" strategy, and also indicate that cargo

[1]Details of these airlines are available at http://www.cksairport.gov.tw, accessed on 2006/4/28.
[2] Available at http://www.cksairport.gov.tw/CKSchi/schedule/airline_c.jsp#, accessed on 2006/4/28.

traffic is very price sensitive. Takase and Morikawa (2005) investigated passengers' hub airport and destination choices in Japan using repeated cross-section disaggregate air passenger data. Ohashi et al. (2005) employed a two–stage least square technique to study factors influencing carriers' choice of air cargo transhipment airports to and from Northeast Asia and indicated that the airport's current traffic flow patterns, airport infrastructure capacity and activities, linkage with regional and intercontinental airport networks, service quality and airport cost are the five major factors that carriers used to choose an air transhipment hub.

According to Frits and Matthias' (2003) study on commercial passengers' air travel and the failure of the hub, new carriers are able to provide better service at a lower price by avoiding large-scale hubs. This is because congestion generated by the hub system has eroded air travel's speed advantage, especially on shorter trips. Marianov and Serra (2003) presented a system model to locate the optimal location of air transport hubs in airline networks to minimise total cost, taking air traffic congestion into account. Tsai and Su (2002) used analytical hierarchical process methodology to assess the political risk if the Taiwan government intends to develop an air logistics hub in northern Taiwan. They indicated that air hub policy and inland freight policy are the top two factors influencing an airport's degree of political risk. Sasaki, Suzuki and Drezner (1999) considered the hub airport selection problem as a one-stop multiple allocation p-hub median problem, and formulated a cost-minimising algorithm model based on the number of passengers and the distance between the 25 U.S. cities they studied.

Nero and Black (1998) examined the increasing externalities associated with hub airports (including increase in environmental costs, e.g. airside and landside congestion, aircraft noise and emissions). Berechman and de Wit (1996) employed a simulation model to study the behaviour of a hypothetical single airline in a competitive market setting, relative to its choice of hub airport. They found that air travel demand patterns, airline cost and production structure, aircraft type and airport charges and capacity are the major factors influencing the chance of an airport becoming the dominant gateway hub in Western Europe.

Authors (year)	Research Foci	Major influencing factors reported
Gardiner et al. (2005)	Freighter's choice of airport	Location, airport quality, third-party influences
Tretheway & Kincaid (2005)	Airport Competition	Price sensitive
Takase & Morikawa (2005)	Passengers' hub airport selection	Passenger flow
Ohashi, Kim, Oum, & Yu (2005)	Forwarders'/shippers' choice of air cargo transhipment airport	Traffic flow patterns, airport infrastructure capacity, connecting times, service quality, airport cost.
Frits & Matthias (2003)	Carriers' selection of hub airport	Airside congestion
Marianov & Serra (2003)	Location of air transport hub	Air traffic congestion
Tsai & Su (2002)	Air logistics hub in Taiwan	Air hub policy, inland freight policy
Sasaki, Suzuki, Drezner (1999)	Hub airport selection	Number of passenger & distance between airports' service networks
Nero & Black (1998)	Hub airport externalities	Airside & landside congestion, airport noise & emission
Berechman & de Wit (1996)	Choice of hub airport	Air travel demand patterns, airline cost & production structure, aircraft type, airport charges, airport capacity

Table 1. Major influencing factors on a hub airport selection

The extant literature is mainly focused on either passengers', shippers' or forwarders' hub airport selection behaviour; however, hub airports are highly dependent on airlines' patronage to thrive (Tretheway & Kincaid, 2005). There is no empirical research that surveys air cargo carriers' perceptions of the importance and

performance of attributes influencing carriers' hub airport selection.

RESEARCH METHODOLOGY

The AHP model is employed because the numbers of air cargo carriers that serve the C.K.S. airport is very limited, meaning that the traditional Multivariate Analysis of Variance technique is not appropriate in this study. AHP includes four axioms: reciprocal relation, relation, pairwise comparison of homogeneous elements, hierarchic and systems dependence, and expectations about the validity of the rank and value of the outcome. The three steps involved in AHP applications are summarised below (Cheng et al., 2006):

1. Construct decision hierarchy with criteria related with the decision goal.
2. Collect input data to perform pairwise comparison of all the decision criteria.
3. Use an eigenvector method to estimate relative weightings of decision criteria.
4. Obtain a composite weight by aggregating the relative weights up the hierarchy to represents the relative importance of each alternative.

RESEARCH DESIGN AND STRUCTURE

A brainstorming session was held with three academicians in the National Penghu University to classify factors influencing carriers' hub airport selection into a hierarchical model, as shown in figure 1. Questionnaires were posted to two major Taiwanese airlines and eighteen leading foreign cargo airlines serving the CKS airport in 2006.[1]

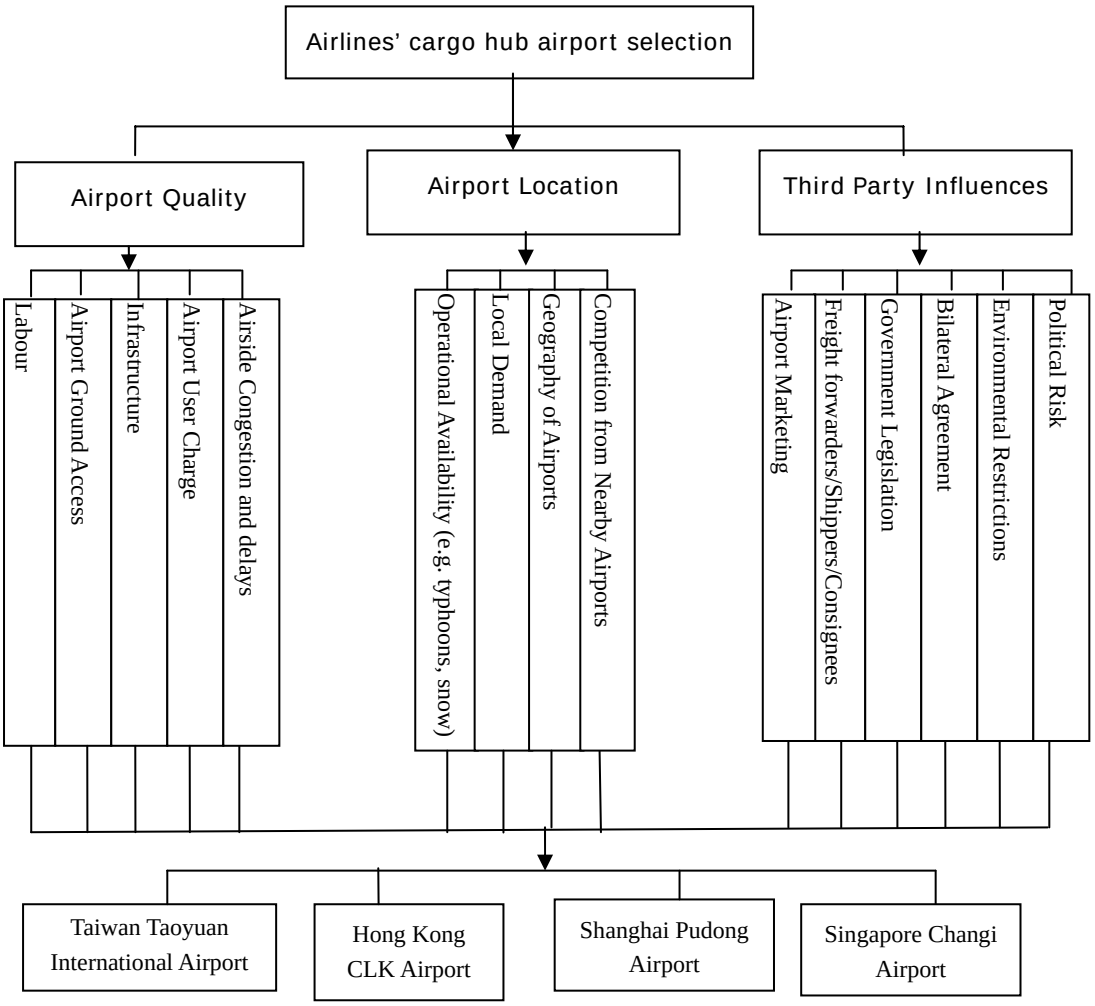


Figure 1. Airlines' freight hub airport selection and decision-making model

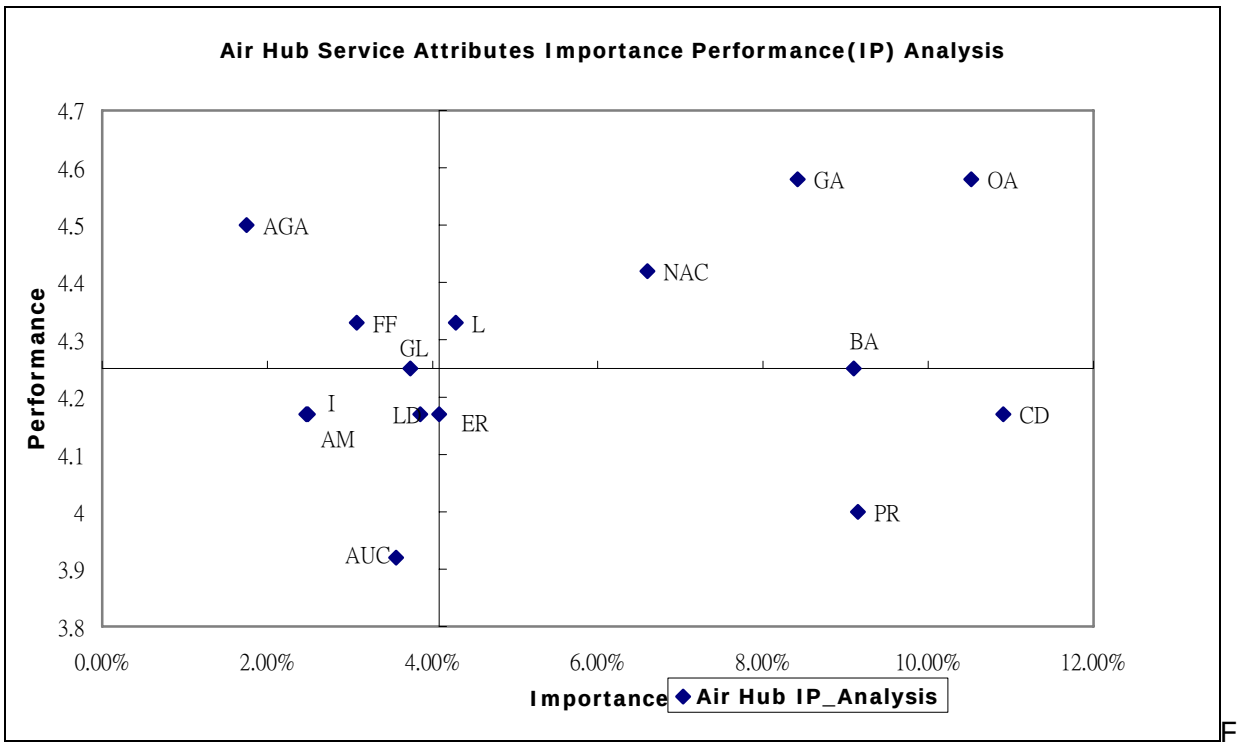
[1] According to Taiwan Taoyuan International Airport's website, there are 19 foreign international air cargo carriers served Taoyuan International Airport, however the author has contacted Martin Air by telephone and found Martin Air had stopped serving Taiwan since 2004. Thus only eighteen foreign carriers were posted questionnaires.

Source: adapted from Gardiner et al. (2005).

RESEARCH FINDINGS FROM PILOT STUDY

In the beginning of this research, a pilot survey were carried out through the author's personal networking, questionnaires were distributed to friends work in two national carriers and two foreign carriers respectively, and all the questionnaires were returned.

As shown in Figure 2, the 'political risk' (PR) and 'congestion and delay' (CD) service attributes were found to be important and the average performance of these two attributes was below the median value of the 15 service attributes employed to construct Figure 1. Put simply, the three airports in the greater China area should spend resources to improve these two service attributes to make themselves more appealing to air cargo transhipment users.



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igure 2. Importance-Performance Analysis of Carriers' Air Cargo Hub Selection in the Pilot Study

Abbreviations: AM: Airport Marketing, GA: Geography of airports, LD: Local Demand, OA: Operational Availability, NAC: Nearby Airports' Competition, CD: Congestion & Delay, AUC: Airport User Charges, I: Infrastructure, AGA: Airport Ground Access, L: Labour, PR:Political Risk, ER: Environmental Restrictions, BA: Bilateral Agreements, GL: Government Legislation, FF: Freight Forwarders/ Shippers/Consignees, AM: Airport Marketing.

RESEARCH FINDINGS FROM MAIN STUDY

After the successfully returned of the questionnaires in pilot study, twenty copies of questionnaires were posted to major cargo carriers served Taoyuan International Airport. Telephone contacts were made before questionnaires were sent to the twenty surveyees. Surveyees employed ed in the pilot study were not included in the main study to avoid response bias generating by their learning effect. Souvenirs were also posted together with questionnaires to increase surveyees' response rate. Twelve copies of questionnaires were replied by these cargo airlines staffs who are either managers or senior staffs work in their business or R&D departments (see Table 2.). As many respondents are managers/senior staff who often travel within the great

China region, and this enable them to evaluate the performance of the four major airports in the Great China region confidently. Thus credibility of the research result is enhanced.

Company	A	B	C	E	F	G
Job Seniority (yrs.)	10+	10+	10+	10+	10+	10+
Job Scope	Business	Business	Business	Manager	Business	Business
Company	H	I	J	K	L	M
Job Seniority(yrs.)	3~7	10+	10+	10+	10+	10+
Job Scope	R&D	R&D	Manager	Manager	Business	R&D

Table 2. Some of Respondents' Profiles

Source: this research.

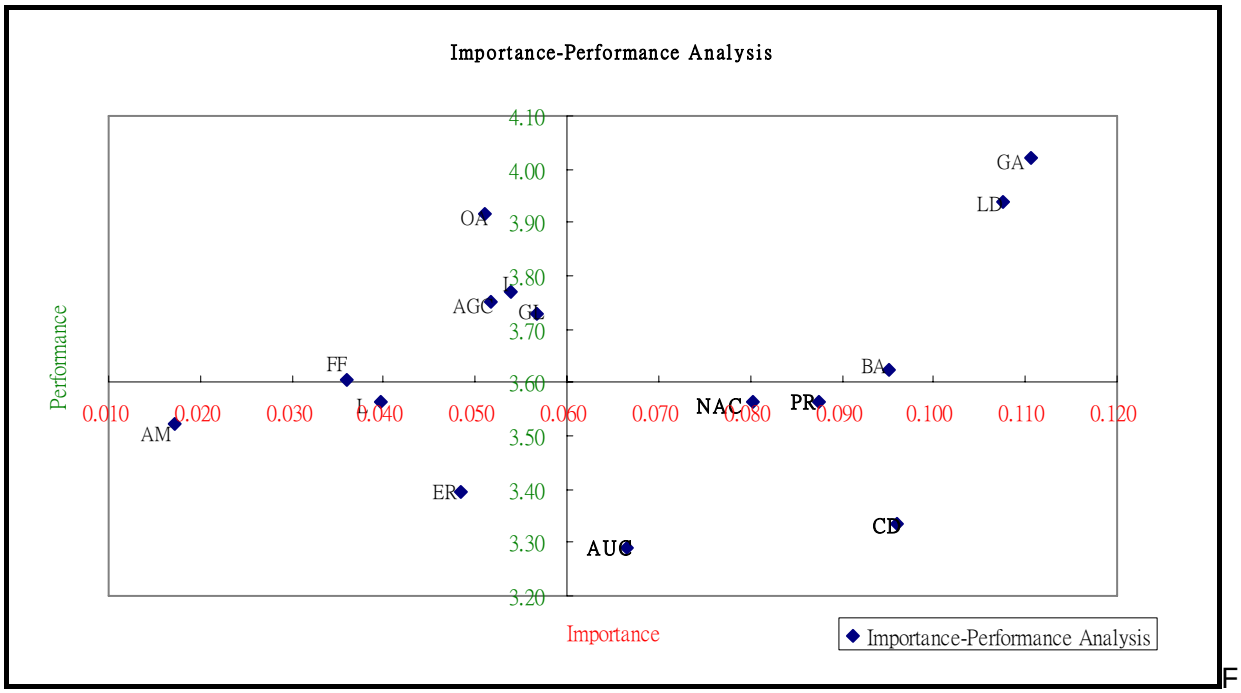
A very similar research results to the pilot survey were found in the main study. The importance of each service attributes are ranked in the Table 3. The three major service dimensions have a very similar degree of importance.

Major Service Dimensions	Service Attributes	Average Weight (Importance)	Ranking
Airport Quality (AQ)		**0.31**	
AQ	Labour	0.040	13
AQ	Airport Ground Access	0.052	10
AQ	Infrastructure	0.054	9
AQ	Airport User Charges	0.067	7
AQ	Congestion & Delay	0.096	**3**
Location (L)		**0.350**	
L	Operational Availability (e.g. Weather)	0.051	11
L	Local Demand	0.108	**2**
L	Geography of airports	0.111	**1**
L	Nearby Airports' Competition	0.080	**6**
Third Party Influence (TPI)		**0.341**	
TPI	Airport Marketing	0.017	15
TPI	FFW/Shippers/Consignees	0.036	14
TPI	Government Legislation	0.057	8
TPI	Bilateral Agreements	0.095	**4**
TPI	Environmental Restrictions	0.049	12
TPI	Political Risk	0.088	**5**

Table 3. Importance rankings of cargo hub airports' service attributes

Source: this research.

Critical service attributes are the attributes have an above median value of importance but have a below median value of performance, and they are located in the lower right quadrant in Figure 3. Again, the Congestion & Delay (CD) and Political Risk (PR) were perceived as critical service attributes by these cargo carriers. In addition, the Airport User Charge (AUC) was also perceived as a critical service attribute in the main study. This may result from the fast hiking of jet oil price between the time of pilot study and the time of main study. Expensive jet oil cost makes cargo carriers more sensitive to Airport User Charge (AUC) as these carriers are struggling to make their both ends meet. International airports in Hong Kong and Shanghai have a much higher landing fee for a Boeing 747-400 than their counterparts in Seoul and Singapore (Ohashi et al, 2005).



igure 3. Importance-Performance Analysis of
Carriers' Air Cargo Hub Selection in the Main Study

Abbreviations: AM: Airport Marketing, GA: Geography of airports, LD: Local Demand, OA: Operational Availability, NAC: Nearby Airports' Competition, CD: Congestion & Delay, AUC: Airport User Charges, I: Infrastructure, AGA: Airport Ground Access, L: Labour, PR:Political Risk, ER: Environmental Restrictions, BA: Bilateral Agreements, GL: Government Legislation, FF: Freight Forwarders/ Shippers/Consignees, AM: Airport Marketing

The rankings of the four cargo hub airports' overall performance perceived by the 12 carriers surveyed do reveal that Hong Kong CLK has the best overall performance, despite its highest AUC (airport user charges) among these four airports. Singapore's and Hong Kong 's overall performances are very close, and Taipei International outperform Shanghai Pudong with a minor margin (see Figure 4). In short, the Shanghai Pudong airport is ranked the last among the four airports surveyed.

However, as one of the surveyees indicated that Taiwan's air cargoes transport growth rate has already slowed down significantly since 2003. Because of carriers' strategic alliance practice and transhipment policy prevails among the Asian air cargo markets, every kilometer ton of Europe and North America bound Asian air cargoes can generate four kilometre tons of transport activities within the Asia region. Eastern China exportes many air cargoes that are currently transhipped through Hong Kong CLK airport, although the CLK has a much higher airport user charges than the CKS

airports in Taiwan. If a cross-Taiwan Strait direct air links cannot be established within a short time period, then this surveyee has predicted that the CKS airport's overall performance will be ranked the last in the very near future.

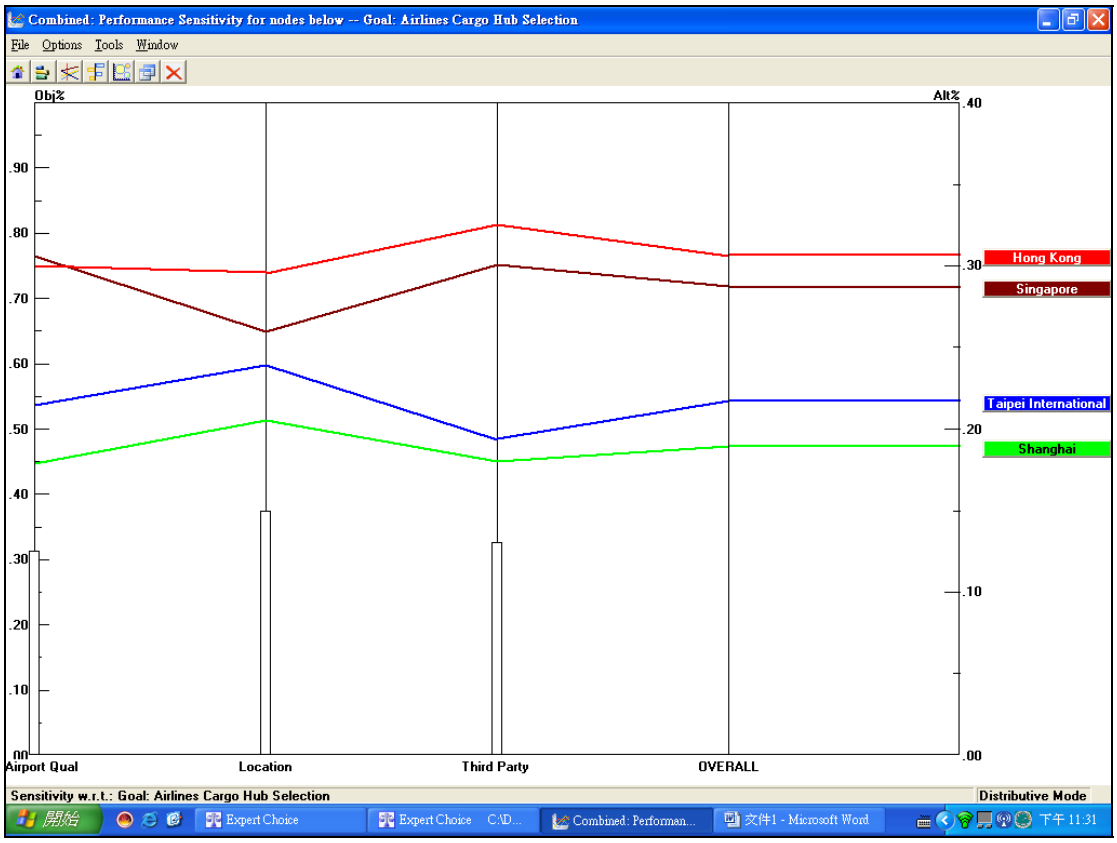


Figure 4. Ranking of four major hub airports in the Great China Region

Source: this research

CONCLUSION AND SUGGESTIONS

'Political risk' and 'congestion and delay' are two sides of a coin in the three airports under investigation in this study. The trade volume between Mainland China and Taiwan has been increasing in leaps and bounds since 1988. Indirect air traffic links between Taiwan and Mainland China through Hong Kong double the air traffic volume in the sky in this region. From the viewpoint of the development of these three air cargo hubs' in greater China', a healthy communication channel should be built between Taiwan and China's civil aviation authorities and direct air traffic links across Taiwan Strait should be made possible. Thus, not only can the 'congestion and delay' situation be improved; 'political risk' can also be significantly reduced under the conditions of friendly direct air service links. Airport users charge (AUC) is one of the most important criteria for carriers to select a cargo hub airport, carriers' sensitiveness intensity on AUC was found increased during the period between pilot study and main study. This suggests cargo hub airports should have a more flexible pricing policy to help carriers overcome their financial difficulties during their business recession period.

The focus of this research is limited to analysing major service attributes of air cargo hubs in only four airports in the great China region. Further research is suggested to include airports in Europe and America, so that a more comprehensive view on the importance of air cargo hubs' service attributes can be revealed. Belly cargoes are another major way to transport high value product with more frequent flights service. Service attributes' importance should be different between all cargo flight carriers, belly cargo carriers, and combined carriers, looking into these differences may be

another avenue for future researches.

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Appendix:

Questionnaire Design of this research entitled 『Study of Airlines' Cargo Hub Airport Selection - A Global Survey』

『STUDY OF AIRLINES' CARGO HUB AIRPORT SELECTION – A GLOBAL SURVEY』

Dear Director/President/Executive,

I am a assistant professor at Penghu University. I am writing to you to ask if you would kindly participate in a survey of airlines' cargo hub airport selection decision-making behavior. This research project is supported by the National Science Foundation in Taiwan. The first part of the survey is focusing on the weight criteria have in cargo airport selection and how they influence your cargo hub airport choice. The second part of the survey is airport specific; it aims to find out overall performance of the four major cargo hub airports in the great China region, namely, Shanghai, Hong Kong, Singapore, and Taipei. Please complete the questionnaire from your viewpoint. This is an academic research and survey results will not be disclosed to any third party. Any geographical or other comparisons will not identify companies by name.

Since there are only a few large air carriers, your opinion is vitally important for my academic research. If you are not sure of the answer to a question, please provide your best-estimated response. If you wish to receive a summary of the survey findings, please return the completed tear-off slip below to me separately and I will be happy to send the summary to you when the research is over. Please send the slip in a separate envelope if you want to safeguard the anonymity of the questionnaire.

I would like to thank you in advance for your kind participation in this survey.

Your faithfully,

T.C. Lirn

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Name of Surveyee:____

Correspondence Address: ____

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I、Questionnaire Structure: The research aims to look into three major critical service attributes influencing airlines' cargo hub airport selection, namely, airport quality, airport location, and third party influences.

（1）Airport quality: Labor force quality, airport ground access, infrastructure, airport user charge, airside congestion and delay.

（2）Airport location: Operational availability (e.g. typhoon, snow), local demand, geography of airports, competition from nearby airports.

（3）Third party influence: Airport marketing, freight forwarders/shippers/consignees, government legislation, bilateral agreement, environmental restrictions, political risk.

II、Explanation and examples of terms and scales used:

If you think criterion A is 9 times more important than criterion B in airlines cargo hub airport decision making, then please circle as follows:

CRITERION	Intensity of Relative Importance																	CRITERION
Airport Quality (A)	⑨	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Airport Location（B）

Circling ⑨ means: From global carriers' perspective, (A) factor (Airport Quality) has extreme importance for airlines cargo hub decision making when compared with (B) factor (Airport Location).

If you think the C criterion is 7 times more important than B criterion in airlines cargo hub airport decision making, then please circles as follows:

CRITERION	Intensity of Relative Importance																	CRITERION
Airport Location (B)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	⑨	Third Party Influences（C）

Circling ⑨ means: From global carriers' perspective, (C) factor (Third Party Influences) has extreme importance for airlines cargo hub airport decision making when compared with (B) factor (Airport Location).

Scales of relative importance:

Intensity of Relative Importance	Definition
9	Extreme importance
8	Demonstrated to extreme importance
7	Demonstrated importance
6	Strong to demonstrated importance
5	Essential or strong importance
4	Moderate to strong importance
3	Moderate importance of one over another
2	Equal to moderate importance
1	Equal importance

III、 The survey

Part one: The Criteria Comparison

1. First Tier Comparison: the relative importance of each major criterion for cargo hub airport selection decision

CRITERION	Intensity of relative importance																	CRITERION
Airport quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Airport Location
Airport quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Third Party Influences
Airport Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Third Party Influences

2. Second Tier Comparison: Relative importance of each sub-criterion for cargo hub airport selection

(1) Airport Quality: Labor force quality, airport ground access, infrastructure, airport user charge, airside congestion and delay.

SUBCRITERION	Intensity of relative importance																	SUBCRITERION
Labor force quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	airport ground access
Labor force quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	infrastructure
Labor force quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	airport user charge
Labor force quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	airside congestion and delay
airport ground access	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	infrastructure
airport ground access	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	airport user charge
airport ground access	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	airside congestion and delay
infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	airport user charge
infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	airside congestion and delay
airport user charge	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	airside congestion and delay

（2）Airport Location: Operational availability (e.g. typhoon, snow), local demand, geography of airports, competition from nearby airports.

SUBCRITERION	Intensity of relative importance																	SUBCRITERION
Operational availability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	local demand
Operational availability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	geography of airports
Operational availability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	competition from nearby airports
local demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	geography of airports
local demand	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	competition from nearby airports
geography of airports	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	competition from nearby airports

（3）Third Party Influences: Airport marketing, freight forwarders/ shippers/consignees, government legislation, bilateral agreement, environmental restrictions, political risk.

SUBCRITERION	Intensity of relative importance																	SUBCRITERION
Airport marketing,	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Freight forwarders/ shippers/consignees
Airport marketing	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government legislation
Airport marketing	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Bilateral agreement
Airport marketing	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental restrictions
Airport marketing,	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Political risk
Freight forwarders/ shippers/consignees	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government legislation
Freight forwarders/ shippers/consignees	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Bilateral agreement
Freight forwarders/ shippers/consignees	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental restrictions
Freight forwarders/ shippers/consignees	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Political risk
Government legislation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Bilateral agreement
Government legislation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental restrictions
Government legislation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Political risk
Bilateral agreement	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental restrictions
Bilateral agreement	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Political risk
Environmental restrictions	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Political risk

Part Two: Evaluating major hub cargo airports' performance in Chinese countries

Please circle one of the five ratio scales 1, 2, 3, 4, 5 to evaluate the performance of the 15 sub-criteria for each airport. Circling ⑤ means an airport has the highest possible performance with reference to the specific sub-criterion; Circling ① means the lowest possible performance)

Hub cargo airports / Selection Sub-Criteria	Taipei Chiang Kai Shek Airport	Hong Kong Chek Lap Kok Airport	Shanghai Pudong Airport	Singapore Changi Airport
1. Labor force quality	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
2. Airport ground access	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
3. Infrastructure	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
4. Airport user charge	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
5. Airside congestion and delay	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
6. Operational availability (e.g. Typhoon, snow)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
7. Local demand	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
8. Geography of airports	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
9. Competition from nearby airports	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
10. Airport marketing	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
11. Freight forwarders/ shippers/consignees	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
12. Government legislation	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
13. Bilateral agreement	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
14. Environmental restrictions	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
15. Political risk	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

Triangle fuzzy set utilized three values to represent a semantic wording. For example, a triangle fuzzy set A can be defined by μ. A. (x) = trianglemf(x,[10,40,60]), where A is the fuzzy set of semantic wording - "Very Poor".

Circling 1 out of the five ratio scales, it indicates the airport has a **very poor** performance on the sub-criterion, and the triangle fuzzy set values are (_____, _____, _____).

Circling 2, it indicates the airport has a **poor** performance on the sub-criterion, and the triangle fuzzy set values are (_____, _____, _____）.

Circling 3, it indicates the airport has a **fair** performance on the sub-criterion, and the triangle fuzzy set values are（_____, _____, _____）.

Circling 4, it indicates the airport has a **good** performance on the sub-criterion, and the triangle fuzzy set values are（_____, _____, _____）.

Circling 5, it indicates the airport has an **excellent** performance on the sub-criterion, and the trapezoid fuzzy set values are（_____, _____, _____）.