A DEMAND ANALYSIS OF CARGO TERMINAL IN TAIWAN'S INTERNATIONAL AIRPORT

Han, Tzeu-Chen
Instructor
Dept. of Shipping and Transportation Management
National Penghu Institute of Technology and
Ph. D Programming Student
Dept. of Shipping and Transportation Management
National Taiwan Ocean University
300 Liu-Ho Rd., Ma-kung, Penghu,
Taiwan, R.O.C.
Fax: +886-6926-5760
E-mail: tchan@npit.edu.tw

Chou, Tsung-Yu
Instructor
Dept. of Marketing and Logistics
Management Ling Tung College and
Ph. D Programming Student
Dept. of Shipping and Transportation
Management
National Taiwan Ocean University
1 Ling-Tung Road, Taichung,
Taiwan, R.O.C.
Fax: +886-2-2463-1903
E-mail: cjy920@ms49.hinet.net

Liang, Gin-Shuh
Professor
Dept. of Shipping and Transportation Management
National Taiwan Ocean University
2 Pei-Ning Rd., Keelung,
Taiwan, R.O.C.
Fax: +886-2-2463-1903
E-mail: gsliang@mail.ntou.edu.tw

Abstract: The purpose of this study is to find out now and potential target market of airport cargo terminal requirements and match up with the "quality gap"; as a reference for the distribution of airport capital under majority government budget source certainly not abundant condition for now and future. This paper examines the difference requirements among airlines, airfreight forwarders, and airport warehouses in Taiwan (Republic of China) airport cargo terminal users. The results revealed that the most important service requirements were e*lectronic document exchange management capability, commitment fulfillment, crises management capability, loading and unloading/conditions upon cargo pick-up, damage compensation service, discounts to customers with large cargo volumes.* The approach utilized in this research could be useful for airport cargo terminal authority to improve their ground handling efficiency and to enhance their overall revenue.

Key Words: airport cargo terminal, ground handling efficiency

1. INTRODUCTION

The Just In Time (JIT) and Integrated Logistics Support concepts have prevailed in business management theories, giving birth to a new production procedure that relies on speed, accurate, reliable services and timely delivery. To cut down on over inventories and cost, many manufacturers are using airfreight transportation. In order to achieve the above goals, creating integrated logistic distribution centers worldwide is vital. As a result, there is an ever-increasing spiral of demand for fast and safe air cargo transportation. This is creating a new production and marketing style, which relies on expedient, precise and dependable with Just in Time cargo delivery capability. According to a research report published in 2001 by Airbus, the growth for international airlines freight tone-kilometers (FTKs) is expected to

grow at an annual average of 5.7% from 2000-2019. Another study conducted by the Boeing Company made an even more optimistic forecast for the same period, estimating that the overall revenue tonne-kilometers (RTKs), which reached 137 billion in 1999, will register a 6.4% annual compound growth to reach 470 billion. Furthermore, Asian airlines' RTKs were predicted to register an 8.6% annual growth rate.

Taiwanese industries' growth is affected by overall global economic changes. Speedy growth in the import-export airfreight is also registering in this region. To take two examples: Taiwan's air freight industry registered growth even in the face of the Asian economic crisis of 1997-2001 and the September 11 terrorist attack on America. In 2001, the total passenger numbers for Chiang Kai Shek International Airport tallied at 1.8 billion passengers, or a 10.3% growth rate over the previous year. However, the total number of freight 119 million tonnes reported in 2001, registered a 17.7% growth rate in the same years. Taiwan's Civil Aeronautics Administration estimated that the Asia-Pacific airfreight market would exceed half of the global market by the year 2010. The growth is even more vigorous once direct link is facilitated across the Taiwan Straits.

Airport cargo terminals occupy an important role in the airfreight transportation business, terminals occupy, specifically air hubs. Hubs are gaining prominence as transferring passengers opt for cheaper tickets, creating delays and operation bottlenecks. Therefore, it is deemed essentials for airlines to seriously take into account the location of operating terminals (Morris, L.S. *et al.* 2003).

In the past ten years, many scholars have probed how to avoid the usual delays and inefficiencies incurred in airside, landside, and airlines operations (Hansen M. 2002; Yan, S. *et al.* 2002; Wu, C.L. *et al.* 2002). Airlines that want changes usually incur extra capital expenditures. Even though the fore-mentioned researchers have solved the airlines scheduling problems, serious obstacles remain within the airlines on ground operations. When studying the conditions the high growth of passengers and airfreight in hub airports, the researchers tend to narrow their focus on a single need of air traffic flow management. Also all are taking the passenger requirements standpoint as the discussion key point.

Such as Lillie et al. (1993) empirical study in British Scottish area airfreight forwarders' purchasing behaviors by using further investigation and several important conclusions can be culled from his paper and implementations. Hamoem (1999) used related documents and interviews to detect whether combination carriers' cargo networks are successful or not due to the lack of an integrated logistics support system. Generally, failures are recorded because companies cannot competitively cut cost by integrate functions such as freight tracking or consistent hub and spoke networks.

Zhang A. used Hong Kong's Chek Lap Kok airport as the model study for China and East Asia, specifically its status as an international air cargo hub. Chek Lap Kok successfully integrates combination carriers' transport and all-cargo transport operations, while at the same time bridging the conditions for international air traffic rights. Forster et al. (2001) investigated US cargo freight industry and hopes for more electronic integration between the senders and the forwarders, in order to increase efficiency. Furthermore related studies made in Taiwan such as Wong, J.T., Liu, T.C. (1999), Yu, M.M., Chang, S.K. (1999), Wong, S.E. and Lee, Y.M. (2000) and so on have been made only focus on passenger transport point of view, or like Tang, L.L. and Kao, C.H. (2000) and so on many scholars, looking at logistics and courier express services. The above studies have focus on freight cargo, but research is lacking for freight cargo ground service needs at international airports.

There is a dearth of research concerning the demands of the integrated carriers (I/Cs), airfreight forwarders (FFs), and combination carriers (C/Cs) at airports. Based on the Cargo 2000 and Unisys' research, a completed transaction between consignor and consignee needs 6.3 day period, resulting in significant losses in time on ground transportation. In the light of these results, this research will discuss the ground operation difference requirements between I/C and C/C, FF and warehouse businesses. The research also urges improvements in operations and management of the international airport cargo terminal and ground operation procedures by analyzing the related requirements of the businesses usage of the international airport cargo terminal and the feature of the operation of the air cargo transportation. Take Chiang Kai Shek international air cargo terminal for example, with the purpose of raising the efficiency of airport cargo terminal to increase the overall competition and profitability and competition. However, there have greatest differences between international air freight service and domestic air freight service arise from the impost revenue and security (including national security and flight safety) needs of states, so that the former must undergo a number of repeated checking procedures (Custom, Immigration, Quarantine - CIQ) on entering and leaving different countries; while the latter need only undergo inspections based on the need for flight safety while operating their service, creating relatively minor and soluble problems comparing with former the transport enterprise taken as a whole. Hence the present study only explores the special needs of airfreight enterprises operating out of international airports.

2. INTERNATIONAL AIR CARGO TERMINAL'S ROLE

During the last decade, the ability of international airport cargo terminals to develop handling skills faced changes and challenges in a more competitive aviation environment. Chinn R.W. *et al.* (1998) evidenced the shipper increasingly demands more information services on quality like safety, cargo tracing, convenience and certain aspects of how the shipment is transported. According to results from an Europe survey about future express and international air cargo market trends reported by Hamoen, F.A.M. (1998), the future competitive environment will increasingly demand distribution efficiencies, shorter delivery lead time, and improve the overall effectiveness of the ground cargo handling. Hamoen, F.A.M. (1998) empirical study found the global market is integrating, this leads to more intensive competition with the need of constantly innovate new cargo terminal services. These innovations emphasis shippers' requirements and offer accessible, reliable, qualitative, time-definite, value added and standardized services.

"Customized" services to fit the client's operational needs are the international airport cargo terminal authority's specialty. To meet the challenge of the more dynamic competitive environment, the international airport cargo terminals need to improve their ground service development (like CIQ-custom, immigration, and quarantine) and documentation systems. The adequate airport cargo terminal means the ability to accommodate flight demand and airport space for the air traffic demand just as clients need for use. Thus, an airport point of interaction of the three major components of the air cargo transports system: The airport (including the ground handling system), the airline (including the integrated carriers and combination carriers), and the shipper (including the freight forwarder and warehousing).

The airport cargo terminal operation's precision involving quality, timing and quantity required of operations within an airport cargo terminal system is equally important for operations the ground handling from the air cargo transportation (Schonberger, H.R.J. *et al.*1883; Tang, L.L. *et al.* 1999).

The fundamental aim of modernizing airport cargo terminal is to ensure that transportation

provides as close as possible a continuous flow from receiving of cargo at the original airport through the destination airport. The success and assurance of performance of the cargo terminal requires an adequate design and the smooth operation of cargo terminal facilities between the airline, the shipper and the warehouses (Taneja, N.K. 1989).

3. Distinct features of Integrated Carriers, Combination Carriers, and All-Cargo carriers

3.1 Air Cargo Transportation Model

Wells, A.T. (1999) and Forster, P.W. *et al.* (2001) classified the international air cargo business into three categories: Integrated Carriers, Combination Carriers, and All-Cargo Carriers.

(1) Integrated Carriers (I/Cs)-Hamoem, F.A.M. (1999) is a network of transportation systems, with their own integrated information network systems, cargo planes, trucks and distribution centers to provide sender and receipt cargo transportation service. The method of transferring cargo is dubbed "desk to desk" service. Companies that fall under this category includes FedEx, United Parcel Service (UPS), DHL Airways and so on.

The working procedure for IC from the deliver to the receiver is described below:

The sender or consignee → Integrated Courier (The sender completely fill out the documents at the warehouse, pay the custom fees such as Visa System used by Fedex. The forwarders process the goods on their own fleet of plane; when the goods arrive at the destination, unloading is processed into the company's own distribution center for processing and deliver.

(2) Combination Carriers (C/Cs) functions similarly to that of airline companies because most of their income comes from passenger freight, with the rest from cargo revenues. However, some airlines-such as Taiwan's China Airlines and Eva Airways, and Germany's Lufthansa and the Netherlands' Royal KLM Airlines-emphasize both markets. These combination carriers appoint their cargo business to one or more airfreight forwarder (FFs) as their agents.

The working procedure for C/C from the deliver to the receiver is described as follows:

Sender→F/F responsible for the operation on the ground process the related export-import documents→goods are sent to the International airport warehouse→A check on import or export items is carried out by the relevant government agency, with cargo terminal personnel handling stocking and packaging→CC handles the transportation, with ground crew contractors to handle the load operation→goods arrive at destination and are unloaded by the ground crew→International airport cargo terminal process and itemize the goods→Related documents are processed and custom duties are paid→the F/F handles customs duties and arranges and schedules deliveries→goods are delivered to the consignees.

(3) All-Cargo Carriers operate multiple cargo delivery services from airport to airport only, in addition to running an airline and airfreight businesses. Airlines and FFs with the all-cargo carriers work together by providing each other with specific conditions and payment terms to ensure cargo space, transit, transit time and other related services.

3.2 Airport cargo terminal ground operation requirements

Recently, Tang, L.L. *et al.* (2000), the production and management concepts has experienced a breakthrough in attempts to reduce inventories in order to reach the goal of zero stock that helps pushing the development of JIT. BTO (Build To Order) production changes are affecting the ways that goods are exchanged, conferring global logistics an important position in the transportation sector. Furthermore, attentions are having been paid to fast and secure delivery.

Gillis C. (1996) and Roe A.G. (2001) point that many researchers have consider that the traditional C/C mode should be essentially change in order to satisfy the demand of international trade. As shown in Baker C. *et al.* (2002) reports on airline business the major airlines are also C/C businesses in the major Asian and top 10 international airports worldwide. According to Zhang A. *et al.* (2002) and Forster, P.W. *et al.* (2001) the complete air cargo business, we found most of the international airfreight business carries goods by C/Cs, especially here in Asia.

The current administrative unit government Taiwan's airports, "Tao-Yuan Air Cargo Park" have the goal of upgrading the Chiang Kai Shek International Airport into an Asia-Pacific Cargo Hub. But C/Cs operations into a hub airport by designating CKS as an original-destination (O-D) airport is unfeasible for the ground crew (See Table 1 and Table 2) (Ashford, N. *et al.* 1997 and Wells, A.T. 1999). Integrating passenger and cargo into a hub faces the difficult problem of (air side) goods inventory. Combining cargo operations time needs to be shortened and passengers' luggage must be processed before cargo goods in order to maintain customer satisfaction. Any transformation will have to effectively face logistics difficulties such as short terminal to terminal transfer time, adequate space for regular and express delivery time, allowing for customers to retrieve their cargo easily and conveniently.

Besides, the needs of passenger baggage and airfreight cargo are entirely different: I/C transport cargo requires special ramps that allow planes to park simultaneously; a distant from the passenger terminal needs to be maintained for handy inventory processing; cargo operations need to be freed from passenger operation disturbances; a steady cargo fleet has to be maintained for smooth processing and delivery. If all the above conditions are met, this will show that the cargo terminal has finally met international standards. And it goes with out saying efficiency will be improved as well. Many difficulties are entailed to upgrade a cargo terminal to international standard. Therefore management is a crucial factor. The management must first figure out the key for operation efficiency before drawing up a blueprint to upgrade Taiwan's airports cargo terminal.

Table 1 Different Requirements between C/Cs and I/Cs at cargo terminal of hub airport

Carriers	Air side	Land side	Location of cargo terminal	Function of cargo terminal
C/C	Efficient time processing by ground crew operations.	Can customs procedure match the requirements of regular airlines?	Near the passenger terminal building, necessary for short-time delivery.	Enough capacity to store of load goods. Capable of long storage time.
I/C	Enough ramps are equipped for cargo planes.	If the warehouse is not in the airport, short customs processing time.	Cheaper rent with warehouse far from passenger terminal building.	Enough capacity to collect cargo (consolidation)

Table 2 Different Requirements between C/Cs and I/Cs at cargo terminal of O-D airport

Carriers	Air side	Land side	Location of cargo terminal	Function of cargo terminal
C/C	How to avoid delay caused by passenger operations	Having enough capacity to store goods and how fast can these goods is processed.	Near the passenger terminal building for fast processing time.	Fit for short term and long term goods.
I/C	Enough cargo ramps and parking space for fleet.	Same as above	Cheaper rent with warehouse far from passenger terminal building.	Enough capacity to collect cargo (consolidation)

4. Research Design and Methodology

4.1 Research questions and hypotheses

In order to understand the present key operation and management problems in international

airfreight terminals experienced by airfreight carriers, airfreight forwarders and warehouses in Taiwan area airfreight market. In accordance with the analytical steps described follow, research questions and hypotheses are shown in Table 3.

Table 3 Research questions and hypotheses

Research Question 1	Do airlines and forwarders show significantly different service requirements? (Forster et al., 2001)
Hypothesis 1	Service demands are significantly different between airlines and forwarders.
Hypothesis 2	Airlines' cargo specific requirements do not always follow the patterns of forwarders' cargo specific requirements.
Research Question 2	Combination carriers' demands are not always what integrated carriers need and the two's interests have become less reconcilable. (Zhang and Zhang, 2002).
Hypothesis 3	Service demands are significantly different between combination carriers and integrated carriers.
Hypothesis 4	Combination carriers' cargo specific requirements do not always follow the patterns of integrated carriers' cargo specific requirements.

4.2 Questionnaire Design

This research is based on Lin K. *et al.*'s (2000) work on Taiwan's international import-export trade business, specifically highlighting the importance of the service sector. To design questions for the draft questionnaire the research examined domestic production documents (Chang, 1996; Hsu, 1998; Lee, *et al*. 1993; Ma, *et al.* 1999; Su, 1991; Tang, *et al.* 2000 and so on), and conducted interviews with experts, government officials, international airlines, warehouse venture capitalists, freight forward companies and key personnel at the Work Administration Centre.

Interviews were also conducted with the senior managers of six domestic warehouses, nine airlines' cargo department managers, and ten freight forwarders' senior managers to elicit their opinions on questionnaire items and content. This study also utilised "Reliability" and "Validity" analysis to effectively gauge the importance of the service attributes selected for the study.

4.3 Sampling and data collection

As a previous section has indicated, at present international airports most international airfreight business is conducted by C/Cs and I/Cs. Moreover, an assessment of the overall international airfreight transportation market undertaken by Forster *et al.* (2001) found the major part of international air cargo business carried out by C/Cs. Therefore, this research's sampling frame comprises all FFs, carriers, and warehouse companies operating at Chiang Kai Shek International Airport in 2002.

After the first draft of the questionnaire was designed in December 2001, several experts in the field were asked to give their views on the questionnaire content. Summarizing this previous body of literature and conducting personal interviews, 31 service demand items were selected for use in the questionnaire survey. These are listed below then sent by mail to 100 airfreight forwarders, 6 airport cargo warehouse companies and 33 airlines operating at the time in Taiwan. The total usable responses were 61, of which 41 had been received from F/Fs, 17 from carriers and 3 from airport cargo warehouse companies at the end of June 2002.

Table 4 All 31 demand service items

Internet processing document management capability (A)
Compensation for damaged or lost goods (B)
Payment (C)
Loading and unloading/conditions upon cargo pick-up (D)
Crises management capability (E)
Commitment fulfillment (F)
Damage compensation service (G)
Electronic document exchange management capability (H)
Rapid cargo tracing capabilities (I)
Rapid problem solving capabilities (J)
Smooth overall operational procedures (K)
Safe Cargo holding capability (L)
Professional knowledge and capability (M)
Consistent delivery service capability (N)
Sincerity in dealing with customers' complaints and dissatisfaction (O)
Comprehensive service by agents (P)
Clear and comprehensive operational procedures (Q)
Website (R)
Suitability and convenience of office location (S)
On time delivery capability (T)
Choices of delivery speed and cargo holding times (U)
Reasonable service charges (V)
Discounts to customers with large cargo volumes (W)
Communication with customers and coordinating time (X)
Efficiency of internal operations, service system (Y)
Total service quality
Handling special cargo capability
Whether does have the standard working procedures
Compensation for damaged or lost goods
Service quality has its value
Secure and accurate documentation (e.g. airway bill) and cargo

4.4 Data analysis method

This study employed factor analysis to reduce a large number of service items provided by an international airport cargo terminal in Taiwan to a smaller number of factors. The factors with an eigenvalue greater than 1 was retained and they can then be used in subsequent analyses. Matrix analysis (Importance- Satisfaction analysis) (M Martilla, J. A. and James J. C. 1977) was used to ascertain the urgent improvement service attributes provided by the airport cargo terminal according to users. T-test was utilized to make the difference test of requirements between combination carriers and integrated carriers, as well as differences between combination carriers and freight forwarders.

5. Results of the data analyses

The *Cronbach* alpha value of all 31 service items in the questionnaire was calculated. Individual service items' correlation with overall items was also calculated; if a service item was eliminated and the overall *Cronbach* alpha value increased this item was not considered in later factor analysis. If a service item's correlation with the remaining items was below 0.5 it was also removed. This process was repeated in order to retain the representative service items for subsequent factor analysis of the 31 original service items, only 25 was found to be representative service items. As a result of factor analysis, these 25 representative items was reduced to 3 strategic dimensions (See Table 5).

5.1 The performance evaluation on international airport cargo terminal by users

A reliability test, validity test, and correlation analysis were conducted to assess whether the strategic dimensions were reliable and valid. The questionnaire's reliability was also tested by the most commonly used statistical coefficient, Cronbach α. If its value was between 0.78 to 0.98, the questionnaire's content was considered highly reliable. Consequently, this research questionnaire reliability for all airfreight user that reliability value of the factors was well above 0.94, which is considered excellent for a satisfactory level of reliability in basic research (Nunnally, J.C. 1978; Sekaran, U. 1992; Churchill, G.A. 1991). The validity of the questionnaire's construction was tested according to Kerlinger (1973) who proposed a part-whole correlation test. In total, six service items were not available for this test due to their correlation coefficient being smaller than 0.5, therefore, these six items were deleted. Of the original 31 service items in the questionnaire 25 remained for factor analysis to reduce them to a smaller set of underlying factor dimensions. Kaiser (1958) proposed the standard that the *eigenvalue* should be larger than one. As a consequence, three strategic dimensions were extracted. In addition, *principal components analysis* with *VARIMAX rotation* was employed for identifying strategic dimensions, the results are shown in Table 5.

Table 5 Factor analyses of service attributes

Factors	**Service attributes**	*Eigenvalue*	Percentage variance (accumulation)
Crises and rapid management capabilities	Crises management capability (E)	11.761	26.107% (26.107%)
	Commitment fulfillment (F)		
	Damage compensation service (G)		
	Electronic document exchange management capability (H)		
	Reasonable service charges (V)		
	Discounts to customers with large cargo volumes (W)		
	Communication with customers and coordinating time (X)		
	Efficiency of internal operations, service system (Y)		
	Loading and unloading/conditions upon cargo pick-up (D)		
Delivery capability and fees	Suitability and convenience of office location (S)	4.312	24.722% (50.829%)
	On time delivery capability (T)		
	Choices of delivery speed and cargo holding times (U)		
	Payment (C)		
	Sincerity in dealing with customers' complaints and dissatisfaction (O)		
	Comprehensive service by agents (P)		
	Clear and comprehensive operational procedures (Q)		
	Website (R)		
	Compensation for damaged or lost goods (B)		
Professional and smooth operational capabilities	Professional knowledge and capability (M)	1.633	19.991% (70.820%)
	Rapid cargo tracing capabilities (I)		
	Rapid problem solving capabilities (J)		
	Smooth overall operational procedures (K)		
	Safe Cargo holding capability (L)		
	Internet processing document management capability (A)		
	Consistent delivery service capability (N)		

This research investigated the object has three types of surveys, besides six warehouse companies by visiting, the airfreight forwarders and the airline by mailing questionnaire, therefore in the material analysis, mainly is focused on the FFs and A/Ls as the main different analysis object, its analysis will aim at level of importance difference and the satisfaction difference analyzes, employed method is T- test. Before carries on each categories difference analysis, we first will carries on three strategic dimensions difference analysis know whether will have the necessity carries on difference examination the detail each small topic. A

comparison of the three strategic dimensions level of difference its result as shown in Table 6, which has remarkable difference existence between F/F and A/L, Therefore Hypothesis 1 was confirmed.

By Table 6 knows service demands have different between FFs and A/Ls at airport cargo terminal, further step is to use T-test analyzes significant service demand differences between FFs and the A/Ls' and to ascertain the reasons for the differences, its result as shown in Table 7.

Table 6 A comparison of the service demand different between F/F and A/L at cargo terminal

Factors	T-value	p
Crises and rapid management capabilities	-2.7**	0.0091
Deliver capability and fees	5.63***	<0.0001
Professional and smooth operational capabilities	4.3***	<0.0001

* p<0.05. ** p<0.01. *** p<0.001.

Table 7 A comparison of the service demand different between F/F and A/L

Service demands	T-value	p
Internet processing document management capability (A)	3.774***	<0.0001
Compensation for damaged or lost goods (B)	4.663***	<0.0001
Payment (C)	3.660***	0.001
Loading and unloading/conditions upon cargo pick-up (D)	1.019	0.312
Crises management capability (E)	-1.166	0.249
Commitment fulfillment (F)	-1.244	0.219
Damage compensation service (G)	-0.764	0.448
Electronic document exchange management capability (H)	-0.776	0.441
Rapid cargo tracing capabilities (I)	2.777**	0.007
Rapid problem solving capabilities (J)	4.073***	<0.0001
Smooth overall operational procedures (K)	6.405***	<0.0001
Safe Cargo holding capability (L)	7.670***	<0.0001
Professional knowledge and capability (M)	4.279***	<0.0001
Consistent delivery service capability (N)	4.908***	<0.0001
Sincerity in dealing with customers' complaints and dissatisfaction (O)	5.496***	<0.0001
Ability to provide comprehensive service (P)	4.729***	<0.0001
Clear and comprehensive operational procedures (Q)	4.152***	<0.0001
Website (R)	5.722***	<0.0001
Suitability and convenience of office location (S)	4.688***	<0.0001
On time delivery capability (T)	6.068***	<0.0001
Choice of delivery speed and cargo holding times (U)	3.869***	<0.0001
Reasonable service charges (V)	-2.421*	0.019
Discounts to customers with large cargo volumes (W)	-1.118	0.268
Communication with customers and coordinating time (X)	-2.137***	0.008
Efficiency of internal operations, service system (Y)	-2.464*	0.018

* p<0.05. ** p<0.01. *** p<0.001.

Table 7 shows the service demands difference between FFs and A/Ls. Now, matrix analysis is used to analyse the cargo terminal service quality gap for users' point of view. A plot of the degree of importance and the degree of satisfaction based on the common service demands of FFs and A/Ls is shown in Fig. 1. Besides, the matrix analysis diagrams with

respect the service demands of FFs and C/Cs are shown in Figures 2 and 3, respectively.

Fig. 1 shows that the degree of satisfaction of each common service demands of FFs and A/Ls is less than the degree of importance. It is obvious that urgent improvement is needed in respect of following service items: *electronic document exchange management capability (H), commitment fulfillment (F), crises management capability (E), loading and unloading/conditions upon cargo pick-up (D), damage compensation service (G),* ***discounts to customers with large cargo volumes (W)***.

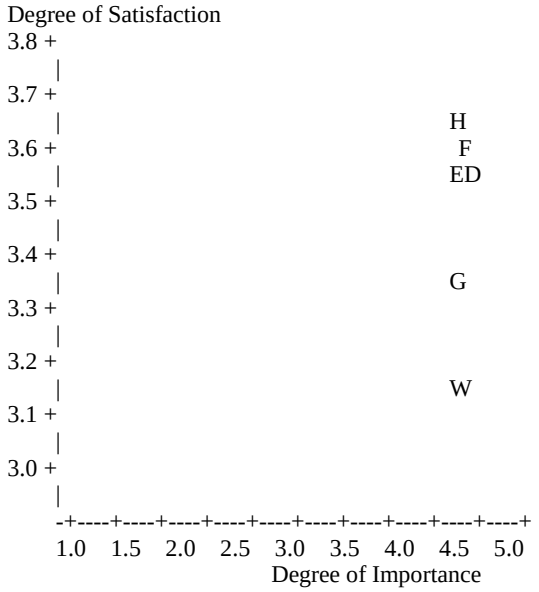
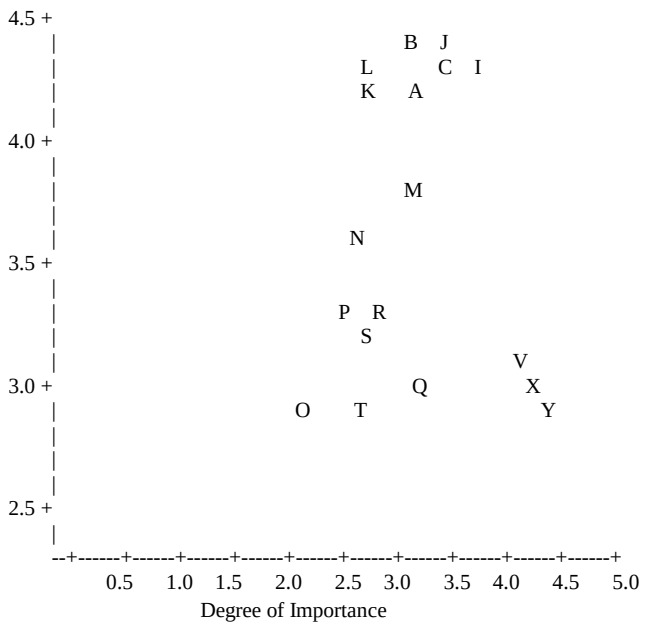


Fig. 1 The matrix analysis diagram of "Cargo terminal service quality gap" for all users points of view

From FFs and C/Cs point of views the reasons are :(1) FFs and C/Cs undertake to transport cargo, which I/C are unwilling to undertake to transport, for example, different dangerous goods, live shipments, valuables, oversize shipments and so on. Therefore, the increasing complexity of operational procedures means an inability to standardise and simplify the execution of tasks. In addition, this kind of airfreight requires different procedures, which, at the same time, must conform to different national customs. Thus this type of airfreight increases the amount and complexity of extra-specialised intelligence information demanded to satisfy regulatory restrictions. Therefore, *(H), (F)* and *(E)* are extreme important for FFs and C/Cs. (2) C/Cs and FFs must work together to internationalise the transportation task. There must be complete cooperation between their organisational dimensions, otherwise shipments will be damaged and the question of indemnity will arise. As a consequence *(D)* and *(G)* also become extremely important for FFs and C/Cs. (3) Due to C/C's main revenue income is from passenger transportation income therefore they will carry passengers as well as their baggage first, and if the aeroplane belly has surplus space, then also carry airfreight. Therefore is unable to arrange how many cargo may undertake to transport in advance, so that is unable certainly to provide consignors with standardised transportation produces services, resulting the responsible FFs are unable to provide the consistent airfreight transportation performance. Therefore, their superiority competition method is " the price ", that is way they urgent need service item *(W)* also the satisfaction lowest item.

There is an obvious difference between the airfreight transportation service demands at the airport cargo terminal of A/Ls and FFs in Figure 2. Regarding airport cargo terminal services, the lowest "Cargo terminal service quality gaps" for A/Ls (not for FFs) are *efficiency*

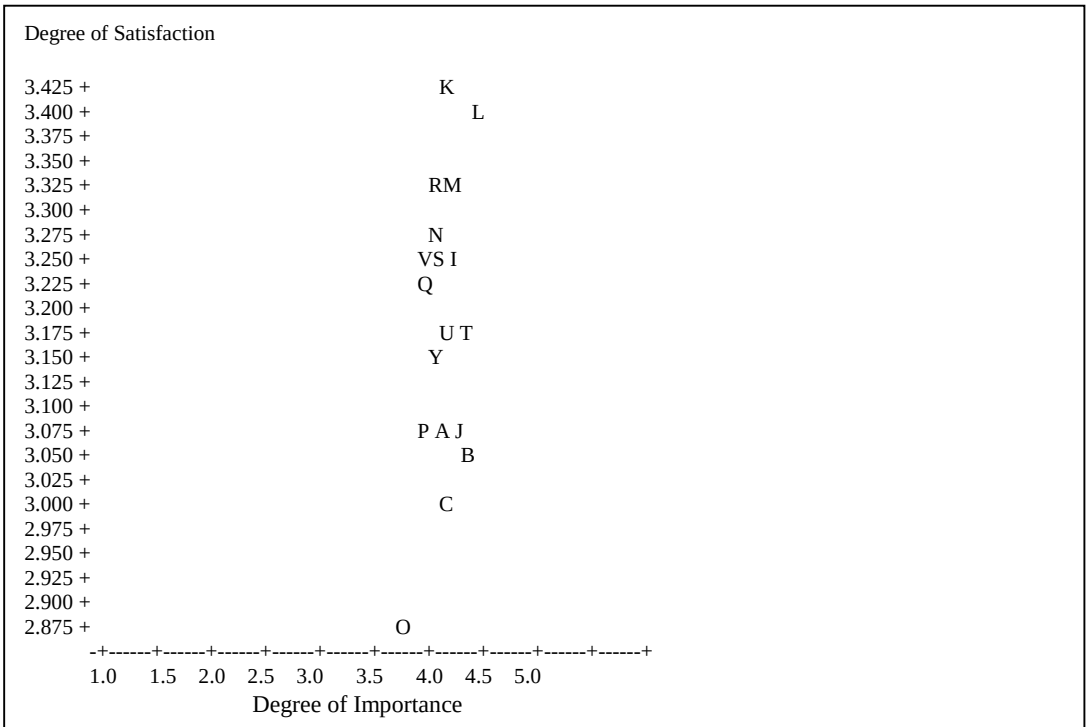
of internal operations, service system (Y), communication with customers and coordinating time (X), and *reasonable service charges (V)*. If cargo terminal internal operations and service system is inefficiency or operational procedures are insufficiently detailed there will be a delay in ground operations contributing to flight delays for A/Ls which may prove very costly in the long-run (Ashford et al. (1997)). Further, if outside airport inter-modal transportation is unable to fast track passengers and cargo this will also contribute to C/Cs' regular flight detention. From the FFs point of views these factors are not so serious.



NOTE: 1 obs hidden.(Q,U)
Fig. 2 The matrix analysis diagram of "Cargo terminal service quality gap" for A/L point of view but not for FF

Fig. 3 shows that s*incerity in dealing with customers' complaints and dissatisfaction (O), payment (C), compensation for damaged or lost goods (B), rapid problem solving capabilities (J), internet processing document management capability (A), communication with customers and coordinating time (X), and ability to provide comprehensive service (P)* are seven service demands where a service quality gap exists at the airport cargo terminal from the FFs point of view. Service demand *(O)* has the lowest degree of satisfaction because FFs act as licensed agents, selling space for particular airlines only. Furthermore, FFs are responsible for handling customs' transactions, the airways bill, as well as the accompanying declaration documentation service. Therefore, if there is any related airfreight transportation problems in respect of these, FFs are responsible for resolving any ensuing difficulties. That is why service demand *(O)* is important for FFs but not for C/Cs. In additions, the international airfreight transpoetation service charges is the most expensive transportation mode, should have the best service performance and the service efficiency. However, FFs are responsible for integrated any related airfreiht transportation parties and conveyances, only then has the possibility achieves the shipper's goal the best service performance and the service efficiency. The correlation parties are more as well as the different national laws and regulations system and the artificial barrier causes the international airfreight transportation work to be more complex, therefore for *(C), (B), (J), (A), (X),* and *(P)* six services demands comparatively

other service items are unable to achieve FFs' anticipated service standard. Thus, from the above analyses, C/Cs' cargo specific requirements do not always follow the patterns of FFs' cargo specific requirements and Hypothesis 2 is therefore confirmed.



NOTE: 1 obs hidden(P,X).

Fig. 3 The matrix analysis diagram of "Cargo terminal service quality gap" for FF point of view but not for A/L

The airline sample for this study was chosen the I/Cs and the C/Cs that the inherent differences in the nature of the structure of delivery service operations, it is foreseeable that all the service demands must be some difference exist for both the I/C and the C/C. Therefore carries on difference analysis for I/Cs and C/Cs that result as shown in Table 8.

Table 8 A comparison of the service demand different between C/C and I/C

Service demand	T-value	P
Internet processing document management capability (A)	1.447	0.169
Compensation for damaged or lost goods (B)	-0.676	0.51
Payment (C)	-0.215	0.832
Loading and unloading/conditions upon cargo pick-up (D)	0.292	0.774
Crises management capability (E)	0.604	0.555
Commitment fulfillment (F)	2.432*	0.029
Damage compensation service (G)	1.323	0.207
Electronic document exchange management capability (H)	0.509	0.618
Rapid cargo tracing capabilities (I)	0.054	0.958
Rapid problem solving capabilities (J)	2.824*	0.014
Smooth overall operational procedures (K)	-0.407	0.690
Safe Cargo holding capability (L)	-0.407	0.690
Professional knowledge and capability (M)	1.091	0.293
Consistent delivery service capability (N)	0.468	0.647
Sincerity in dealing with customers' complaints and dissatisfaction (O)	0.558	0.585
Comprehensive service by agents (P)	-0.438	0.668
Clear and comprehensive operational procedures (Q)	0.220	0.829
Website (R)	-0.154	0.879

Suitability and convenience of office location (S)	-0.933	0.366
On time delivery capability (T)	-0.470	0.645
Choice of delivery speed and cargo holding times (U)	-0.506	0.620
Reasonable service charges (V)	0.060	0.953
Discounts to customers with large cargo volumes (W)	1.871	0.082
Communication with customers and coordinating time (X)	4.583***	<0.0001
Efficiency of internal operation, service system (Y)	1.485	0.158

* p<0.05. ** p<0.01. *** p<0.001.

By way of the matrix analysis knows I/C and C/C have the difference service demands, which the obvious different categories are *commitment fulfillment (F), discounts to customers with large cargo volumes (W)*(Though bigger than 0.05, the service demand item *W*'s p-value approachs to 0.05.)*, and communication with customers and coordinating time (X). Especially the category (X)* has the highest degree of difference exists between the I/Cs and the C/Cs.

Aforementioned service demands differences due to following reasons. First, I/Cs often provide consignors reliable, convenient, standardize, and punctual transportation service for its customers in order to increase market share. Especially vice as suits to each kind of urgent need goods and document material ship. The characteristics of the I/Cs is safe and rapid, so the I/Cs must grasp transportation process each link. I/Cs strengthen service quality of transportation ability, own all assets of production, including physical assets such as trucks, airplanes, and information network, each is indispensable. Then possibility truly has the monitoring system-wide cargo movement performance, resulted increasing consignors satisfaction *(X)* and decreasing expenditure for I/C.

The C/Cs main income is from the passenger transportation income therefore will carry passengers as well as the passenger's baggage first, if the airplane belly has surplus space then carry the airfreight. As aforementioned, C/Cs commit their cargo business to one or more airfreight forwarder (F/F) as their agents, who are responsible for handling customs transactions, the airways bill, and so on. However, the same C/C in the different airport his agents are not same. As a result it increases complexity of operations diversity of procedures and practices, therefore regarding *commitment fulfillment (F)* and *communication with customers and coordinating time (X)* are unable to achieve same efficiency as the I/Cs. Regarding *discounts to customers with large cargo volumes (W)* actually have the very big elasticity, because airfreight income is only the small parts for C/Cs. As mentioned earlier, airfreight income is only income source for I/Cs, so regarding category *(W)* compares with C/Cs was inelastic. So Hypothesis 3 is true.

Because most of the international airfreight business carries goods by C/Cs, especially here in Asia, C/Cs transportation task must penetrate the different organization and organization's division cooperation complete. In addition, Taiwanese area airfreight "Trade Value Added Network (trade VAN) service scope is unable to penetrate in the Internet with the world other national systems on-line, further between the different cooperative organization's network connection is not completely compatible. Therefore most majority airports cargo terminal is unable to provide similar service level like I/Cs' service level that provide standardized, simplification, and speed of airfreight service standard.

This attribute just like Table 5 demonstrated all users to the international airport cargo terminal service attribute most important strategic dimension (factor) is "crises and rapid management capabilities". Because C/Cs in order to meet the passenger's requirements that fly non-stop, directly to their destination, whenever possible. If a transfer is needed, they prefer the connecting time at the hub airport to be as short as possible (Carlton, D.W. (1980)).

Therefore frequently is unable to ship the cargo on schedule (Because C/Cs in order to maintain flights scheduled on time rates, to off-load originally scheduled airfreight and without any notice). Because C/Cs usually provides no service guarantees, offer little or no tracking capability and typically the fees is lower. Therefore the same goods ships the expense take the Asia to North America cargo movement as the example, such as I/C charges $4.26 to 8.70 per kilogram from Taipei to New York, but C/C only charges $2.23 to 2.90 per kilogram from Taipei to New York (According to different cargo's volume weight or cross weight and different airlines, can have difference in the price).

Therefore can see the C/Cs most priority consideration are decreasing passengers' total travel time and short airplane waiting time at airport period, the secondary consideration then is the airfreight transportation demand. For the I/Cs most important consideration is provided superior service (JIT service) at a premium price for consignors. By providing time-definite, guaranteed, desk to desk service supported by real-time shipment tracking service. Based on this research and Hamoen, F. A. M. (1999) study found the C/Cs and I/Cs processing ship the cargo the operation steps, have the extremely big difference. Former completes entirely transportation task approximately needs above 40 steps, but latter completes entirely transportation task approximately only needs 7 steps. That is why C/Cs and I/Cs have the obvious different service demands for the cargo terminal. As above analysis Hypothesis 4 passes through the confirmation for really.

5.2 Conclusion

The above analysis shows that air cargo delivery specialists in Taiwan feel there must be urgent improvement in the airport cargo terminal; however, there is disagreement on which items need change. Due to the inherent differences in the nature of the structure of delivery service operations, it is foreseeable that the airport cargo terminal is unable to satisfy all the demands of the users. Therefore, whenever airport management plans to build a new airport or expand a presently existing airport, items which both airline and FF consider important are priority factors, which must be considered. In the present study these priority items were: *Electronic document exchange management capability (EDI) (H), Commitment fulfillment (F), Crises management capability (E), Loading and unloading/conditions upon cargo pick-up (D), Damage compensation service (G), Discounts to customers with large cargo volumes (W).*

Further, because each type of air cargo has different delivery requirements, planning must take into consideration the needs of individual airport operational conditions (hub airport and original—destination airport). Therefore, in addition to considering the above information, air cargo management of international airports must also respond to the future trends of its airport's social and economical environments as the best operational reference model for international airport cargo terminal research and planning.

ACKNOWLEDGEMENTS

This research was supported by a grant (NSC-91-2211-E-346--003) from the National Science Council of Taiwan. We special thanks are due to the Taiwan Civil Aviation Bureau and the relative experts for their assistance in collecting the material and valuable opinions. We also would like to thank the anonymous referees of the International Scientific Committee of the EASTS for their helpful comments and suggestions on the presentation of the paper.

REFERENCES

1. Anonymous (2002) **Civil Aeronautics Administration Fact Book**, Civil Aeronautics Administration; Taiwan
2. Ashford, N., Martin Stanton, H. P., Moore, C. A. (1997), **Airport Operations,** 2nd Edition, McGraw-Hill 1997
3. Baker C. and O'Toole K. (2002) Negative growth, Airline Business, London, June, 51-56
4. Carlton, D.W., Landes, W.M. and Posner, R.A. (1980) Benefits and costs of airline mergers: a case study. **Bell Journal of Economics Vol. 11 No. 1**, 65-83
5. Chinn R.W. and Vickers, K. (1998) Automated air cargo handling systems, **Colloquium on Systems Engineering of Aerospace Projects,** IEE. UK. London, UK, 114-118
4. Chiu, S.S. (1996), Express cargo processing zone at CKS int'l airport, **Institute of Transportation,** 46
5. Churchill, G.A. (1991), **Marketing Research: Methodological Foundations**, 5th ed. The Dryden Press, New York.
6. Dillman, D. A. (1978), **Mail and Telephone Surveys: The Total Design Method**. New York: John Wiley & Sons, Inc.
7. Forster, P. W. and Regan, A. C. (2001) Electronic integration in the air cargo industry: An information processing model of on-time performance, **Transportation Journal**, Summer, Vol. 40, Issue 4, pp. 46 - 61
8. Gillis, C. (1996) The Changing World of Freight Forwarding**, American Shipper, Oct, Vol. 38 No.10** 49
9. Hamoen, F. A. M. (1999) Combination carriers and a dedicated air cargo hub-and-spoke network, http://www.tiaca.org./researchpapers/hamoen.html, CH 2 pp. 2.9.
10. Hansen, M. (2002) Micro-level analysis of airport delay externalities using deterministic queuing models: a case study, **Journal of Air Transport Management Vol. 8,** 73-87
11. http://www.tiaca.org/cm/G2/I25/
12. Humphreys, I., Francis, G. (2000), Traditional Airport Performance Indicators A Critical Perspective, **Journal of the Transportation Research Board No.1703,** 29
13. Jen, W., Lin, W.T., and Hu, K.C. (1997) Study on Later-Entrants Competitive Advantages of International Courier Service in Taiwan, **Journal of the Chinese Institute of Transportation, Vol. 10, No. 2**, 59-78
14. Kaiser, H. (1958), The Varimax Criterion for Analytic Rotation in Factor Analysis, **Psychometrika,** Vol. 23, pp. 187-200
15. Kerlinger, F. N. (1973), **Foundations of Behavioral Research**, CBS International Edition
16. Lillie, M. and Sparks, L. (1993), The Buying Behaviour of Air Freight Forwarders, **International Journal of Physical Distribution & Logistics Management, Vol. 23 No. 1,** 14-22.
17. Lin, K., Liang, G.S. and Han, T.C. (1990), Analysis on shippers for the segmentation airfreight market, **Proceedings of first seminar of cross strait for shipping science and technology,** 89-96
18. Lyon, E. More travelers take flights from Harrisburg, Pa., airport, **Knight Ridder Tribune Business News**; Washington; Jan 23, 2003
19. Ma, W.Y., Chiu, H.C., and Hsieh, Y.C. (1999) A Study on the Evaluation of Service Quality Items of Hi-tech Corporations in Hsinchu Science Industrial Park for bank, custom, and transportation industry's performance, **Taipei Bank Monthly Journal, Vol. 29, No. 6**, 124-145
20. Martilla, J. A. and James J. C. (1977), Importance-performance analysis, **Journal of Marketing, No. 1,** 77-79

21. Morris, L.S., Ga, M. (2003) Airport adviser listens to travel concerns, **Knight Ridder Tribune Business News**; Washington; Jan 23
22. Nunnally, J.C. (1978), **Psychometric Theory**, 2nd ed. McGraw-Hill, New York.
23. Porter, M. E. (1980), Competitive Strategy: Techniques for Analyzing Industries and Competitors, Free Press
24. Roe, A. G. (2001), Industry Growth Drives Need for New Air Cargo Facilities, ENR**, New York, January, Vol. 246 Iss. 1,** 23
25. Schonberger, H.R.J. and Gilbert, J.P.(1883) Just-in-Time Purchasing: A Challenge for U.S. Industry, **California Management Review Vol. 26, No. 1,** 54
26. Schwartz, B. M. (1998), Competitive Pressures Drive Forwarders to Advance, **Transportation & Distribution, Vol. 39, No. 2,** 99
27. Sekaran, U. (1992), **Research Methods for Business**, 2nd ed. Wiley, New York.
28. Shiau, W.S. (2001), Air cargo traffic development demand correlation topic research, **Proceedings of national freight transportation development policy seminar- Air traffic,** 35-39
29. Su, I.S.I. (1991) Investigating the Logistical Integration of Joint Delivery in Distribution Channel by a Theoretical Case with Practical Consideration, **Journal of the Chinese Institute of Transportation, Vol. 13, No. 3**, 63-76
30. Taneja, N.K. (1989) **Introduction to Civil Aviation**, Lexington Book, New York, 2nd edition, 195
31. Tang, L.L. and Kao, C.H. (2000) The Model of International Logistics Performance Evaluation – Case for BTO Operation Model, **International logistics seminar Journal,** 343-353
32. Wells, A. T. (1999) **Air Transportation - A Management Perspective**, 4th Edition, Wadsworth, 364-387
33. Wong, J.T., Liu, T.C. (1999) The Characteristics and Development of Taiwan's Air Market, **Transportation Planning Journal, Vol. 28, No. 3**, 451-483
34. Wong, S.E. and Lee, Y.M. (2000) The Impact of Domestic Airline Regulation Relaxation on Level-of-Service Quality, **Transportation Planning Journal, Vol. 29, No. 2**, 397-438
35. Wu, C.L. and Caves, R.E. (2002) Modeling of aircraft rotation in a multiple airport environment, **Transportation Research part E Vol. 38,** 265-277
36. Yan, S., Shieh, C.Y., Chen, M.J. (2002) A simulation framework for evaluating airport gate assignments, **Transportation Research part A Vol. 36,** 885-898
37. Yu, M.M., Chang, S.K. (1999), An Assessment on Level of Service of Domestic Airlines, **Civil Aviation Journal Quarterly, Vol. 1, No. 3**, 303-329
38. Zhang A., (2003) Analysis of an international air-cargo hub: the case of Hong Kong, **Journal of Air Transport Management, Vol. 9**, 123-138