

THE AIRPORT CHOICE OF CARGO OPERATORS

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ABSTRACT

In air transport research, some time has already been dedicated to the study of how passengers choose their airports as well as to the airport choice of passenger airlines. However, much less research has been carried out with regard to cargo operators and their choice of airports. This paper is a step towards better understanding the relationship between air cargo operators and airports. In the first section the market environment of air cargo is sketched to position the research in the general field of air transport. Air cargo traffic developments as well as a categorization of air cargo are presented. Furthermore, the main subjects of this research are introduced: the airlines and airports. Subsequently, a literature review about airport choice is carried out, revealing the airport choice process and important factors which influence the airport choice of cargo carriers. The choice factors can be clustered in six groups: restrictions, time factors, cost factors, market factors, strategic factors and the perception of airport quality. Concluding, the study suggests that more in depth research should be carried out in the field of the airport choice of air cargo carriers. It is recommended that the focus of this research is laid on freighter operators, meaning the all-cargo divisions of combination carriers as well as the all-cargo carriers but excluding integrators due to their different business model. Finally, the results of this study and further research in this topic will help to better comprehend how air cargo carriers choose their airports and ultimately how airports can form their strategies to attract air cargo carriers.

Keywords: air cargo, airport choice, cargo airline, airport

1. INTRODUCTION

During the last decades, air cargo has developed from a by-product of air transport to an important part of business for airlines as well as airports. Traffic growth has been strong and more and more airlines pay particular attention to air cargo and even formulate their own strategies regarding this part of the air transport sector. Moreover, the number of airports focussing on air cargo is increasing.

However, in air transport research, studies concerning the air cargo sector are still quite limited. For example, some time has already been dedicated to the study of how passengers choose their airports (e.g. Blackstone et al. (2006) and Hess et al. (2007)) as well as to the airport choice of passenger airlines (e.g. Berechman and de Wit (1996)). Much less research on the other hand has been carried out with regard to cargo operators and their choice of airports. The main objective of this paper is to bridge this gap in research as well as to contribute to a better understanding of the relationship between air cargo operators and airports.

To reach this aim, the paper first off all addresses the market environment of air cargo to position the research in the general field of air transport. The evolution of air cargo traffic in comparison to passenger traffic is sketched to underline the growing importance of the air cargo sector. This is followed by an outline of the categories of air cargo. Especially the distinction between air cargo transported in combi aircraft and in all-cargo aircraft is made clear, while also their evolution is discussed. The remainder of the chapter is devoted to the main subjects of this research: the cargo airlines and the airports. In section 2.3 the different cargo airlines are introduced. Some examples of the importance of air cargo for those airlines are also given. The last part of the chapter outlines the main cargo airports. It was chosen not only to present the biggest cargo airports worldwide but also to focus on European airports as future research might concentrate on the European setting.

The second chapter of this paper attempts to provide an overview of the airport choice factors of cargo airlines. The main target of this part is to examine what we can learn about airport choice factors in literature. First, the airport choice process is presented. Second, the factors of airport choice are examined. The factors are grouped under seven different headings: market factors, restrictions, time-factors, cost-factors, strategic factors, airport quality and the perception of airport quality and other factors.

Finally, lessons of the paper will be drawn and suggestions given for future research.

2. THE AIR CARGO ENVIRONMENT

In this section an insight is provided into the market environment of air cargo as the market environment forms the framework for the airport decision of cargo airlines. First, the importance of air cargo is sketched in comparing the evolution of cargo traffic with that of passenger traffic. Second, the difference between combi-traffic and all-cargo traffic is made clear. This is followed by an outline of the most important cargo airlines and airports with the aim of introducing the main actors of this research.

2.1. Evolution of worldwide air freight

During the last 30 years, air cargo has known a tremendous growth. Figure 1 shows the increase in air cargo traffic from 9 million tonnes in 1975 to about 40 million tonnes in 2008, a growth of 450%. This growth can be attributed to amongst others increasing trade, changes in production processes, deregulation etc. An increasing trend can also be seen in the freight-tonne kilometres, where a growth of more than 800% took place in the same period. The reason for the stronger increase in freight tonne-kilometre is the globalisation process which resulted in decreasing trade restrictions and therefore increasing global trade which stimulated not only the growth of transport but also lead to increasing transport distances.

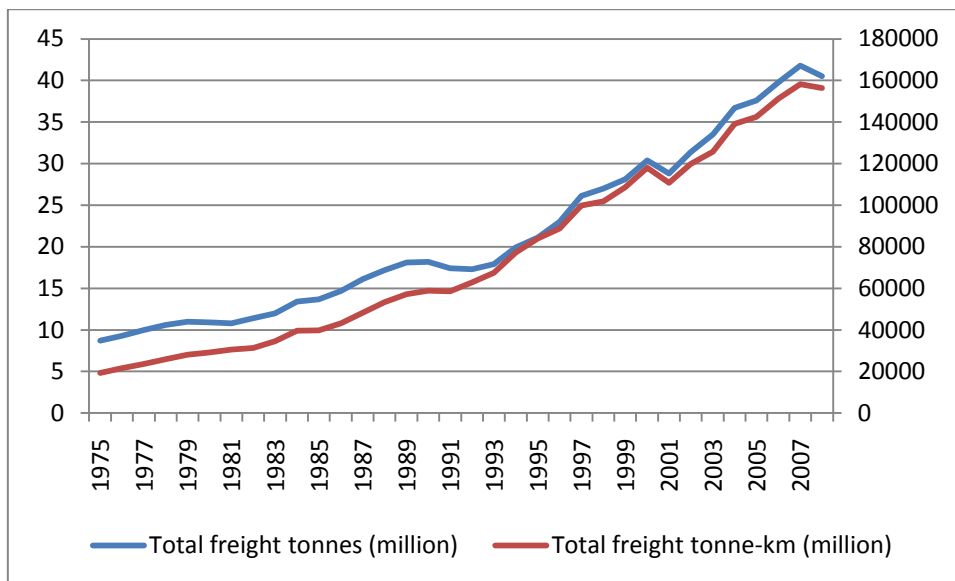


Figure 1 - Evolution of worldwide air freight (1975-2008)

Source: Based on ICAO data

Comparing the evolution of freight traffic with the one of passenger traffic (see Figure 2) it can be seen that passenger-kilometres increased with about 610%, therefore less than freight kilometres. Especially in the 90s, the cargo traffic knew a stronger growth than passenger traffic, due to numerous market openings such as in Europe.

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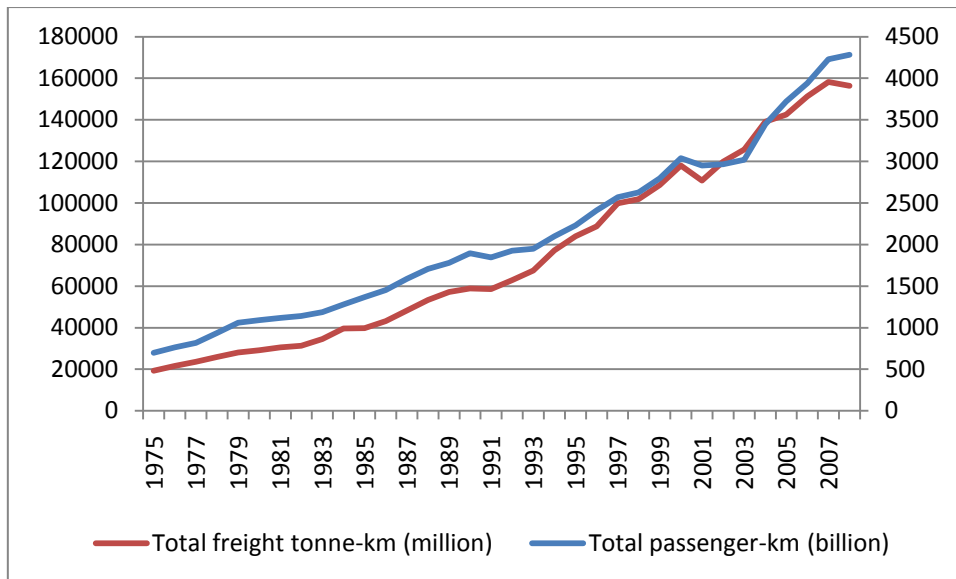


Figure 2 - Evolution of worldwide freight traffic vs. passenger traffic (1975-2008)

Source: Based on ICAO data

Figure 1 and Figure 2 also show the decrease in traffic in 2001, due to the 9/11 terrorist attacks, and in 2008, due to the worldwide economic downturn. In general, air cargo traffic often reacts more dramatically to crisis situation than passenger traffic but on the other hand also rebounds faster as is shown in Figure 3. Since 1975, air cargo has suffered only six years from a negative growth. The first negative growth years in 1980 and 1981 can be attributed to the worsening economic climate, the increasing oil prices and decreasing demand during the second oil crisis. In 1991 and 1992, growth rates again dropped below zero because of high oil prices and the worldwide recession in the early 1990s. The last two times when negative growth numbers can be seen this was due to the 9/11 attacks in 2001 and the worldwide economic recession in 2008.

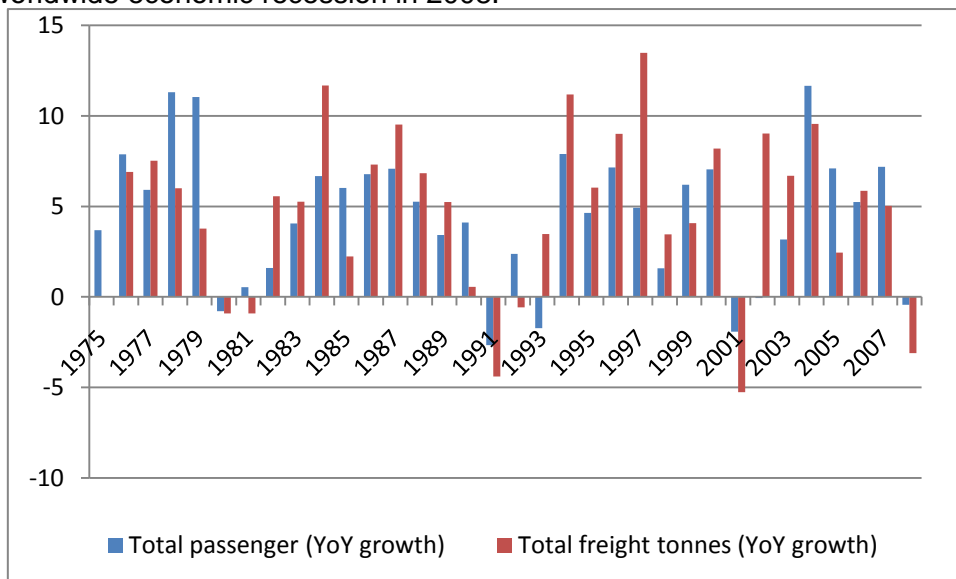


Figure 3 - Year on Year growth of freight tonnes vs. passenger (1975-2008)

Source: Based on ICAO data

2.2. Categories of Air Cargo

Air cargo can be looked at from two different perspectives. First of all air cargo can be looked at from the perspective of where it is transported. Here a difference is made between air cargo transported in the combi-aircrafts or in full freighters. Combi-aircrafts are here defined as aircrafts that next to passengers can transport cargo, either in the belly of the airplane or in the main deck. On the other hand, air cargo can be divided into general cargo, express cargo or postal cargo.

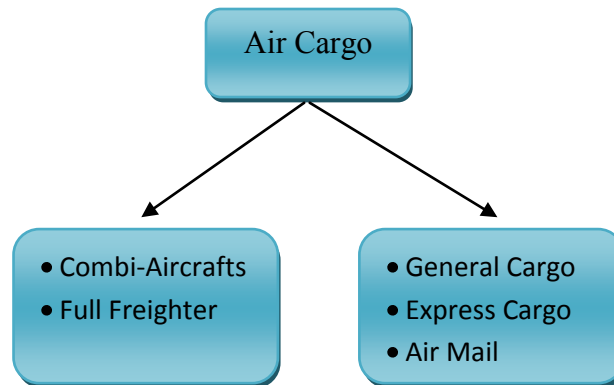


Figure 4 - Categories of Air Cargo

Of the three different kinds of cargo, general cargo is worldwide the most important, with the highest share of revenue tone-kilometer. General cargo was first introduced in the US in 1931 (Wensveen, 2007, p. 323) and can be defined as cargo on pallets and in containers, in contrast to packages, which is less time-sensitive than express cargo .

Express Cargo on the other hand includes very time-sensitive cargo that is often transported in small packages. In the last decennia, Express Cargo has grown at more than twice the rate of General Cargo, with an average annual growth of 11% before 2000 and 8.7% after 2000. Its share in world air cargo has also grown from 4.1% in 1992 to 13.2% in 2008. (Boeing, 2008, p. 5) The growth of Just-in-Time (JIT) concepts is one of the reasons for the growth of express cargo. (A. Zhang & Y. Zhang, 2002)

Although one of the pioneers of air cargo, air mail nowadays has the smallest share in air cargo worldwide. Since 200 its share decreased from 4.7% to 2.7% in 2008. (own calculations based on IATA 2009, p.11) Moreover, while general cargo and express cargo increased in the aforementioned timeframe, air mail decreased with about 16.3%. This decrease can be attributed to the trend of digitalization of written documents which, in numerous cases, makes the transport of documents obsolete.

Air cargo, either general, express or air mail, can be transported in the in combi-aircrafts or in full-freighters. Here full-freighters or “dedicated freighters” are defined as airplanes dedicated to cargo in contrast to combi-aircrafts, which also transport passengers. However, full-freighters are not to be confused with all-cargo carriers, as combination carriers can also operate full-freighters. During the last 30 years, decreasing capacity on passenger airplanes,

more stringent security measures, differences in the flows of passengers and cargo as well as the tendency towards consolidation and growing demand for air cargo let towards a growing share of all-cargo traffic. (Herman & Van de Voorde, 2006) This phenomenon can be found in the number of ton-kilometres as well as in the freight tons carried. Figure 5 shows the proportion of freight tonnes changing from about 40% all-cargo traffic and 60% combi traffic (air cargo transported in the belly space or combi-aircrafts) to 50% all-cargo traffic and combi-traffic¹. Since 2002, all-cargo traffic in tonnes even has a slightly larger share than combination traffic. However, also the share of all-cargo traffic and combi-traffic differs between routes. While wide-body airplanes with sufficient capacity for cargo dominate the domestic Asian market, narrow-bodies with less cargo capacity are deployed in the domestic US market, which makes the use of full-freighters more popular. Concerning the future, as cargo traffic is growing faster than passenger traffic, all-cargo traffic will become even more important and combination carriers that do not invest in all-freighters will be losing market share. (Conway, 2006)

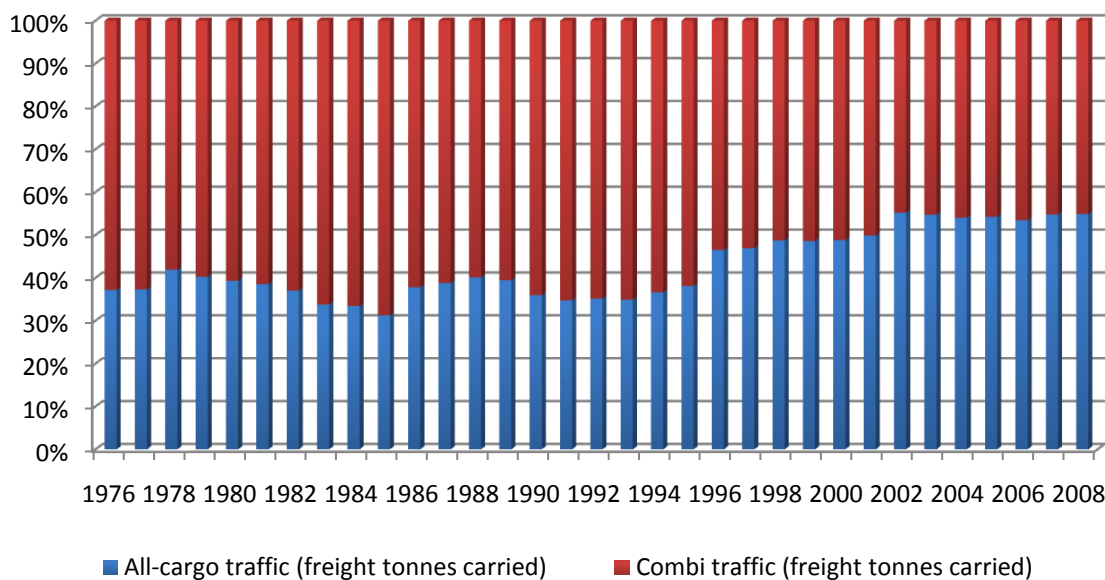


Figure 5 - Evolution of the share of all-cargo and combi traffic international and domestic (scheduled services)

Source: IATA World Air Transport Statistics, 1981-2007, IATA Members' Air Transport Operations

In order to gain insight into the development of all-cargo and combi traffic, the annual changes of both are depicted in Figure 6. As already shown in Figure 2, the effects of the second oil crisis in 1979, the Gulf War and economic recession at the beginning of the '90s, the terrorist attack on 9/11 2001 and the economic crisis beginning in 2008 can be seen in the evolution of freight traffic. It is clear however, that all-cargo traffic is much more volatile than combi traffic. Take for example the beginning of the 1990's: while combi traffic still shows a growth in 1990, all-cargo traffic already decreased due to high oil prices and stagnating demand. In 1991, also combi-traffic shows negative growth numbers, still less

¹ Proportions and evolution based on IATA data.

serious than for all-cargo traffic. On the other hand, once the economic situation improved, all-cargo traffic shows a much higher growth as can be seen in 1992 and especially 1994.

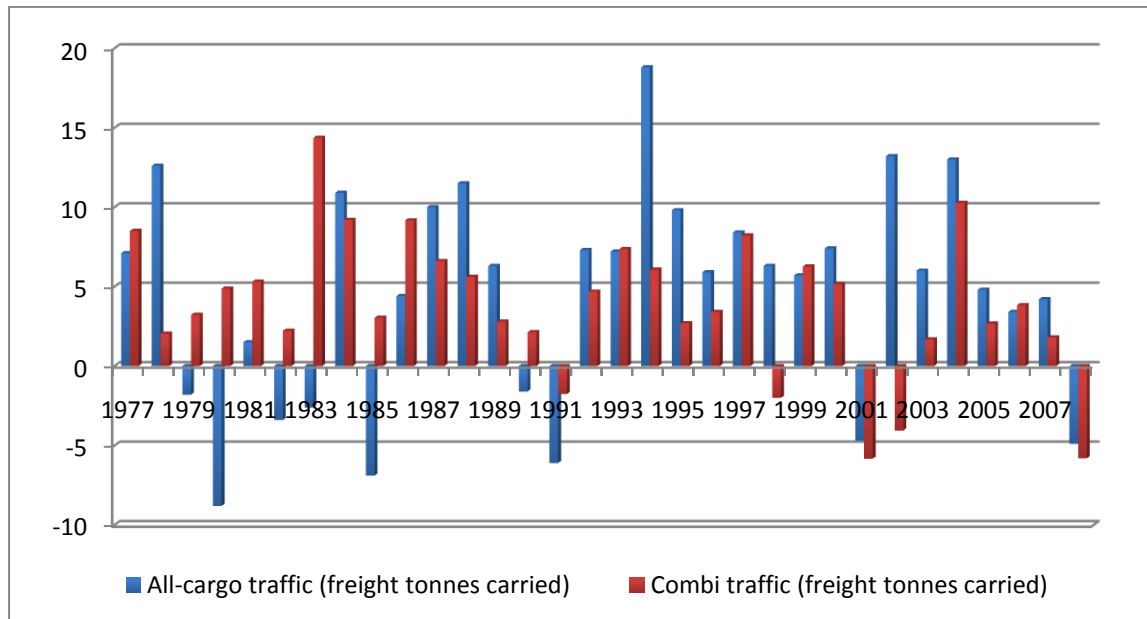


Figure 6 - Annual % change of freight tonnes of all-cargo and combi traffic

Source: based on IATA data

2.3. Cargo Airlines

In air cargo, three kinds of carriers are serving the market: integrated carriers, combination carriers and non-integrated freight carriers. Integrated carriers “provide an integrated door-to-door service, merging four principal elements: (1) ground fleet of pick up/delivery trucks, (2) terminals for sorting and processing freight, (3) long-haul truck fleet for moving freight between terminals, and (4) an air fleet for moving freight between airports.” (Hall, 2002, pp. 4, 5) Although integrators often focus on the transport of small time intensive cargo and as for example packages, during the last years a trend towards an increase of general cargo transported by integrators can be seen. The “Big 4” of the integrators are UPS, TNT, FedEx and DHL.

Non-integrated freight carriers on the other hand use full-freight aircrafts mainly for general cargo. However, they might also offer door-to-door services for a number of countries, as for example Emirates Sky Cargo does. (Emirates Sky Cargo, 2010) Non-integrated freight carriers offer mainly scheduled services but outsource their services also to other airlines. In contrast to integrated airlines, non-integrated freight carriers serve a narrower geographic market. The biggest non-integrated freight carrier is Cargolux.

The last category of airlines is the category of combination carriers. Combination carriers focus mainly on the transport of passengers, but also carry cargo in combi-aircraft or even full-freighters. Examples for combination carriers are Korean Air, Singapore Airlines, Lufthansa and Cathay Pacific Airways. Cargo accounts for only about 5 to 10 percent of the

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total revenues of the combination carriers in the United States (Wensveen, 2007, p. 326), but is far more important for European carriers (13.4%) and even more for Asian carriers, for whom air cargo accounts for about 30-35% of total traffic revenue. (Air Cargo Management Group, 2006, p. 36) This can also be seen in Table 1 and Figure 7.

Place	Airline	Cargo revenue share
1	Eva Air	45.3%
2	China Airlines	43.5%
3	Korean Air	30.6%
4	Asiana Airlines	27.8%
5	Cathay Pacific	25.2%
6	Singapore Airlines	24.3%
7	Emirates	19.3%
8	Malaysia Airlines	18.2%
9	China Eastern Airlines	18.1%
10	Thai Airways	15.6%

Table 1 - Passenger airlines with largest cargo revenue 2006²

Source: Conway, 2006

Of the 10 airlines with the largest share of cargo revenue, nine airlines are Asian airlines and only one has its home base in the Middle East. The reason for the high share of cargo revenue for Asian carriers is first of all the importance of air transport due to long distances in Asia as well as missing infrastructure for other modes that could form an alternative for air cargo.

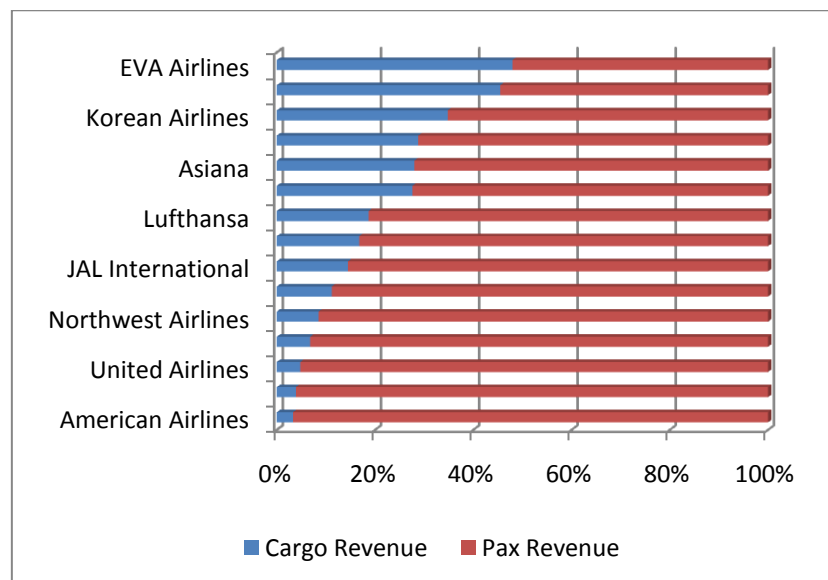


Figure 7 - Cargo revenue as % of total traffic revenue

Source: International Air Freight and Express Industry Performance Analysis 2006, Air Cargo Management Group 2006, p.36

² Only top 50 passenger airlines considered.

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Of the combination carriers shown in Figure 7, American carriers as American Airlines, Delta and United Airlines have the lowest share of cargo revenue, which comes mainly from the fact that in Northern America, the integrators have a very high share of the air cargo market. However, we see in the last years, that air cargo becomes more and more important also for combi airlines and even few American airlines could survive in particular on their long-haul flights without cargo. (Conway, 2006)

Rank	Airline	Country	Type of carrier	Millions of Tonne-km
1	Federal Express	US	Integrated	15,122
2	UPS Airlines	US	Integrated	10,977
3	Korean Air	South Korea	Combination	8,890
4	Cathay Pacific Airways	Hong Kong	Combination	8,245
5	Lufthansa	Germany	Combination	8,206
6	Singapore Airlines	Singapore	Combination	7,486
7	Emirates	United Arab Emirates	Combination	6,013
8	Air France	France	Combination	5,820
9	Cargolux	Luxembourg	All-Cargo	5,334
10	China Airlines	Taiwan	Combination	5,261
11	British Airways	United Kingdom	Combination	4,702
12	KLM	The Netherlands	Combination	4,646
13	Japan Airlines	Japan	Combination	4,286
14	EVA Air	Taiwan	Combination	4,076
15	Air China	China	Combination	3,396
16	Asiana Airlines	South Korea	Combination	3,326
17	American Airlines	US	Combination	2,557
18	Malaysia Airlines	Malaysia	Combination	2,444
19	United Airlines	US	Combination	2,404
20	China Eastern Airlines	China	Combination	2,379
21	LAN Airlines	Chile	Combination	2,346
22	Northwest Airlines	US	Combination	2,330
23	Thai Airways	Thailand	Combination	2,289
24	Qantas Airways	Australia	Combination	2,206
25	All Nippon Airways	Japan	Combination	2,068

Table 2 - The world's biggest cargo airlines by type 2008

Source: Ranking and tonnage based on Top 50 Cargo Airports (Air Cargo World, 2009a)

Table 2 shows that the major part of the top 25 of the biggest cargo airlines are combination carriers. However, the two biggest cargo airlines are two integrated carriers, FedEx and UPS, which shows the importance of integrated carriers. In the table, only one all-cargo carrier is represented. With 5,334 millions of ton-kilometer, is Cargolux the 9th biggest cargo carrier in the world.

2.4. Airports

Airports, as the infrastructure provider to airlines, are forming a very important part of the air cargo environment. As deregulation in the world increases and more open-sky agreements are negotiated, new possibilities for competition, not only for airlines but also for airports are created. Still airports seem to have a lot of market power. This, as Starkie (2008) discusses, does however not come from their 'natural monopoly' as a result of high fixed costs, but rather from the difficulties associated with the access to competing sites. Although more and more open sky agreements are discussed, the air transport sector is still dominated by bilateral air service agreement, which often do not only prevent airlines to compete but airports also lack the incentive for competition. Services can only be operated from an airport in a country that has a bilateral agreement with the destination country. (Starkie, 2008) That is why especially for intercontinental routes, bilateral agreements still play an important role in the airport choice of cargo airlines.

To have a better idea about the cargo going through worldwide airports, the world's biggest airports are shown in Figure 8. The biggest airports by far are Memphis and Hong Kong with both about 3.7 million tons of cargo in 2008. Memphis's important position is due to the fact, that world's biggest cargo airline FedEx build up their hub in Memphis. Hong Kong on the other hand is evolving into an important logistical hub in Asia. With some exceptions, like Anchorage and Louisville, we can see that many hubs, that are also very important for passenger traffic, are also big cargo airports.

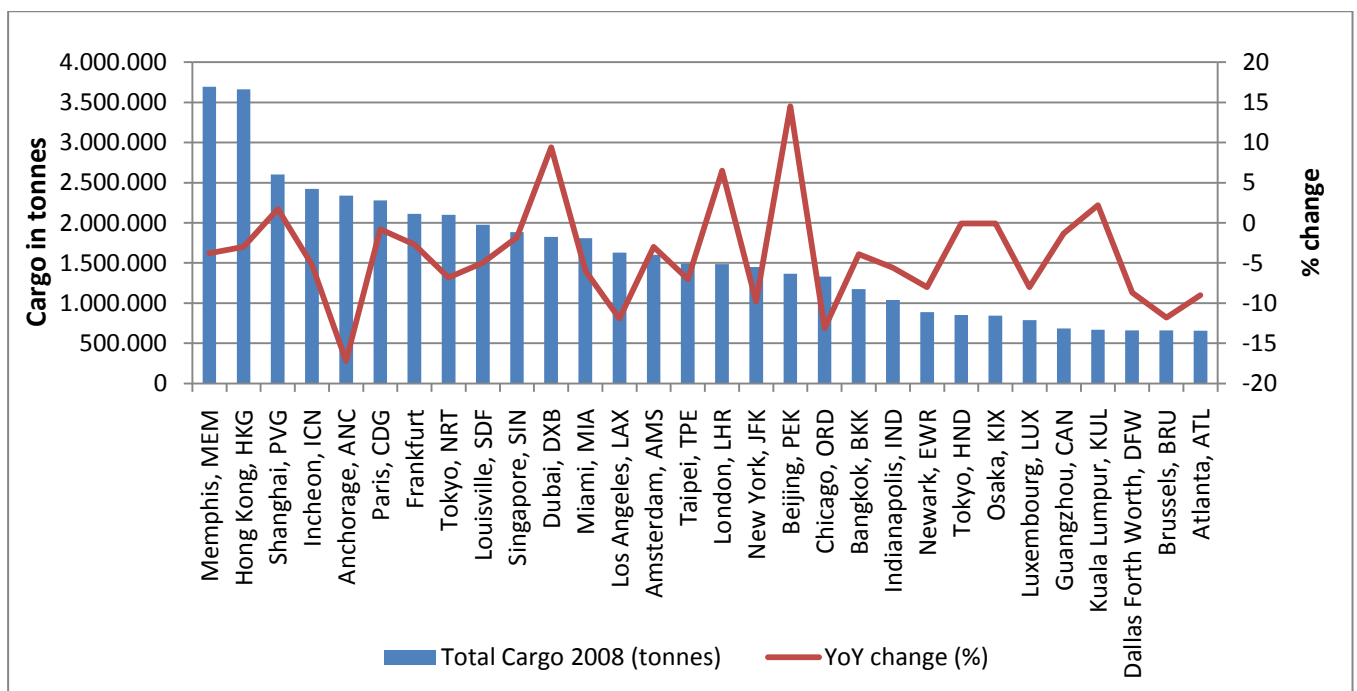


Figure 8 - World's biggest cargo airports 2008

Source: Top 50 Airports (Air Cargo World, 2009a, pp. 18-19)

Figure 8 also shows the change in cargo in 2008. Here it becomes apparent that due to the economic crisis starting mid-term 2008, most of the airports show a negative growth. Only 5 airports of the top 30 airports have shown a positive development in 2008, of which three

Asian airports (Shanghai, Beijing and Kuala Lumpur), one European airport (London Heathrow) and one airport in the Middle East (Dubai). The recession especially hit hard in North America, with cargo volumes dropping most in Anchorage, Los Angeles LAX and Chicago. In Europe Brussels and Luxembourg were hit most seriously.

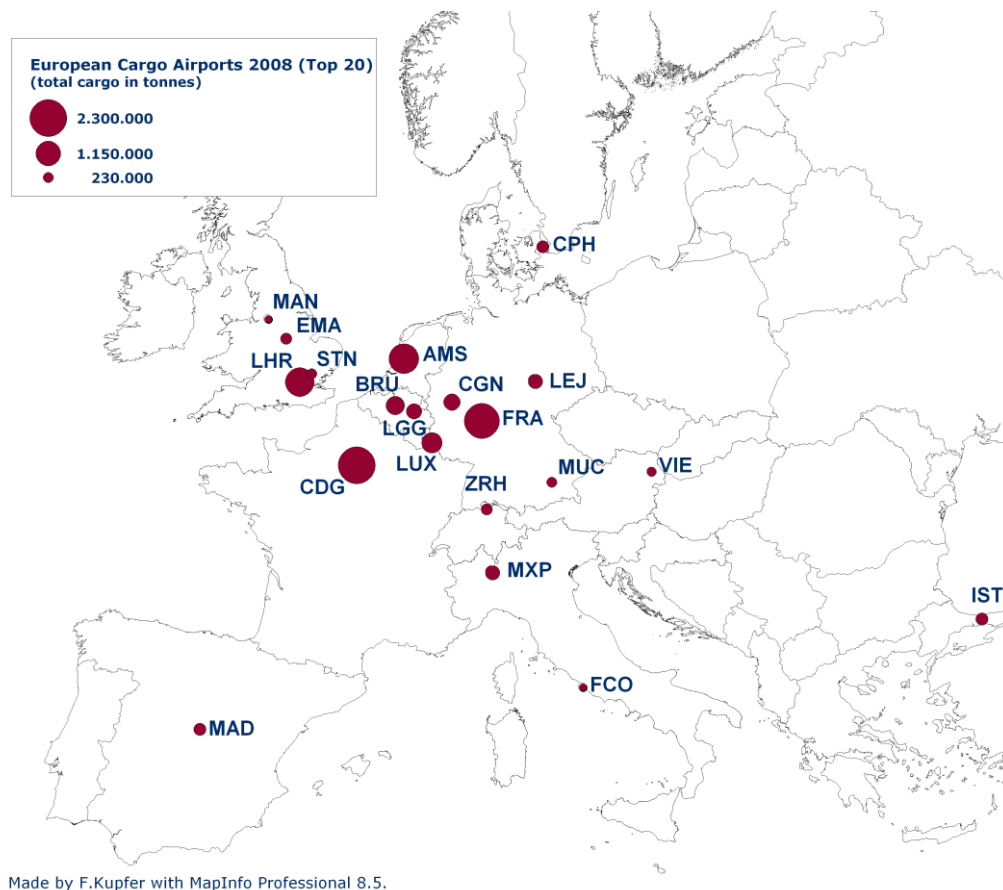


Figure 9 - Top 20 European Cargo Airports (2008)

Source: ACI

After describing the biggest cargo airports worldwide, the analysis is further focused on the European airports. The top 20 airports for cargo in 2008 in Europe are depicted in Figure 9. The most important cargo airports in Europe are clearly Paris Charles de Gaulle, Amsterdam Schiphol, London Heathrow and Frankfurt. The area between those three airports is also known as the Golden Triangle, as almost 66% of European freight transits within this zone. (Allett, 2008, p. 6) After the four big airports, there is a group of airports with a freight volume between 200 000 and 600 000 tons. This group also includes airports that play a smaller role in the passenger business but specialized themselves in air freight. Examples of those airports are Liège, Brussels, Cologne/Bonn and East Midlands. The smaller airports shown in the map are mostly only feeding airports, from which the freight is transported to major hubs.

In 2008, the airport that gained the most traffic was Leipzig/Halle Airport which was able to become the European hub of DHL. Cargo traffic on Leipzig/Halle grew with more than 400% (see Air Cargo World, 2009a). However, due to the economic recession most European

airports knew a decrease in traffic. Cologne/Bonn, Manchester, Brussels and Luxembourg were amongst the airports that experienced the most sincere fall in traffic with a negative growth of respectively -18.6%, -14%, -11.8% en -8%.

As for the cargo airlines worldwide, also the top 20 of the European cargo airports in time can be analyzed. It can be seen, that the top 7 of the airports has not changed since 2003. Remarkable is, as mentioned, the ascent of Leipzig, which entered the top 20 quite high on rank 9 in 2008. (own analysis based on Air Cargo World)

In contrast to the ranking of the European airports by volume, where the top 7 stayed the same over time, the Air Cargo World Excellence Survey which is conducted yearly by Air Cargo World reveals that the airports constantly have to work on their image and service to satisfy their customers and gain on their competitors. Even if a certain airport is judged as excellent in one year, this does not automatically mean it will be evaluated as excellent the next year. In 2007, Milan Malpensa together with Frankfurt received the highest score, only to be judged very badly in 2008. On the other hand, airports that do not perform very well today can with some effort gain the confidence of their customers as Barcelona who saw a tremendous improvement from 2009 to 2010, with scores climbing from 93 to 138. (own analysis based on Air Cargo World)

3. AIRPORT CHOICE FACTORS

The third part of this study presents the airport choice process and provides an overview of the airport choice factors. The airport choice factors are grouped into seven categories which are discussed separately: market factors, restrictions, time-factors, cost-factors, strategic factors, airport quality and perception of airport quality and other factors.

3.1. The Airport Choice Process

When deciding which airport to operate to, every airline goes through a different choice process. This process often depends on company regulation, conventions and experience. However, some general directions of the airport choice process can be given.

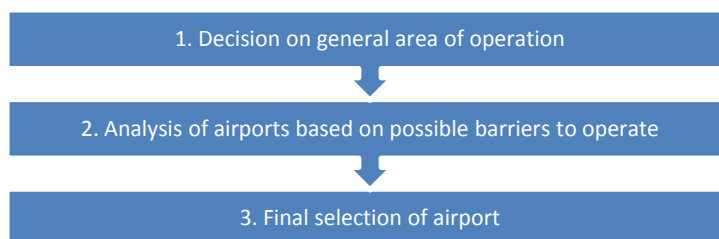


Figure 10 - The Airport Choice Process
Own composition based on Gardiner et al. (2005)

Gardiner et al. (2005) identifies the airport choice process as a three-stage process, which is pictured in Figure 10. First of all the airline decides about the general area of the origin/destination airport. This choice is strongly driven by market factors such as the O-D demand and the presence of forwarders, which can be seen as a proxy for demand. After having decided on the general area, the airline will exclude airports where due to restrictions and other barriers, it cannot operate. Such restrictions might include night time restrictions, where the carriers need night time slots, or even infrastructural deficits. Last but not least will the airline compare all remaining airports to decide on their individual merits and finally decide on the origin/destination airport.

3.2. Market Factors

Airport choice factors that refer to the size of the air cargo market around the airport as well as the access to this market are grouped as market factors. Those factors include origin-destination demand, the presence of forwarders, market access, road access and intermodal access.

The market factors origin-destination demand is often one of the first factors an airline considers when choosing which area to operate to. Here a difference between the choice of a hub-airport and origin-destination airport becomes clear. Concerning the hub choice, with all factors equal, the ideal place for an airline would be a central location which minimizes the total flight kilometres and cost within its network. (A. Zhang, 2003) For origin-destination airports however, demand was revealed as one of the most important airport choice factors. Especially the location nearby an economic cluster seems to be preferred as economic clusters can be an indicator of demand. (Gardiner & Ison, 2008) However, origin-destination demand was more important to carriers that operate short-haul services as carriers with long-haul services have a wider market. (Gardiner, Humphreys, & Ison, 2005b, p. 395)

While the location of an economic cluster can be seen as an indicator for market demand, so can be the presence of forwarders around the airport. The importance of the forwarders also becomes clear with the fact that also in the forwarding business there is a trend towards concentration. Big forwarders like Kühne & Nagel, who acquired ACR Logistics in 2006, and Panalpina integrate more and more small companies which increase their market power. On the one hand, when gaining one of the bigger forwarders as customer means more business for the airlines. On the other hand, when losing one of the forwarders, it also often means losing a large share of business. That is why airlines often follow their main customers to airports or at least strongly value the presence of forwarders around airports. Lufthansa Cargo is one example of an airline that chooses its destinations by looking at their customers. The airline expanded their services at Leipzig-Halle in October 2009 as one of their customers (Otto Group) distribution centres is situated about 130km northwest of the airport. Lufthansa started to handle the inbound shipments for Hermes Transport Logistics, a subsidiary of the Otto Group, in August 2009 and now also handles the distribution to the its logistics centre. (Air Cargo World, 2009b)

As important it is for airlines that there is a market for air freight around the airport, also the market access is of very high importance. It is not enough to transport cargo to and from an airport without being able to transport it to the final customer. It could even be seen that the access to crucial markets is even more important than the proximity of the market itself. (Gardiner et al., 2005b) For the market access, often good connections with other modes of transport are necessary. A study about the air cargo service quality in Korea for example revealed that international airlines even rank the interconnectivity of the transportation on airports highest. (Hong & Jun, 2006) In particular good access to road networks is seen as important by airlines. Road connection is especially important to smaller regional airports that specialize in cargo traffic. The main competitive advantage of those airports is congestion free operations on the air- and on the landside, that the main airports in Europe often cannot offer anymore. However, the interconnectivity includes more than just the connection between road and air. Also the access with other modes has to be considered. If an airport neglects trucking and rail, it can miss out on about 80% of the opportunities to attract cargo. (Page, 2003)

3.3. Restrictions

As a second step of the airport choice process, the cargo airlines look at restrictions to operate. One of the most sincere forms of restrictions is the bilateral restrictions between countries. Since the Chicago Convention, the commercial aspects of international air transportation have been mostly covered by bilateral agreements between countries. Studies by Zhang (2003) and Zhang et al. (2004) show that traffic rights are especially important for the attractiveness of cargo hubs. In their studies, the case of Hong Kong was put forward as in 2003 it still applied a 'one route, one carrier' policy. This means that on a specific international route, only one Chinese and one foreign airline are allowed to operate an agreed capacity. (A. Zhang, 2003; A. Zhang et al., 2004) Such restrictions however, hinder the airports in their development and also restrict airlines in their strategies. In Europe since the deregulation of air transport in the 1990's, all restrictions for European airlines on fares, routes and number of flights have been removed to create a single European aviation market. European cargo airlines that fly inside Europe are thus not hindered by any traffic right restriction. However, for airlines also serving markets outside Europe, bilateral agreements or open sky agreements are still of utmost importance and influence their choice of airports.

When we look at the more local level, the airport level, the provision of infrastructure becomes important for an airline to be able to operate to a specific airport. Airlines need a certain minimum of infrastructure to be able to operate on an airport. Infrastructure such as warehouse facilities can be of utmost importance for some airlines and forwarders. (Zhang 2003, p.135) Other examples of necessary infrastructure are sufficient ramps, parking spaces, runways and terminal capacity. (Page, 2003; Kingsley-Jones, 2000) Moreover, the infrastructure is expected to fit the need of air cargo and to be maintained and improved or expanded if necessary. (Hall, 2002; Berechman & de Wit, 1996)

Other factors that restrict airlines in using certain airports are noise and night time restrictions. General noise restrictions effect in particular operators that use all-freighters as cargo aircraft are often older and louder aircrafts than passenger airlines. With many airports in Europe introducing noise related charges, those aircraft bring higher costs to the airlines and the higher the costs at an airport, the more unattractive it becomes for cargo airlines. Night time restrictions as a special case of noise restrictions are most important specifically for integrators, as they have a need for night flights as their network operations are build on the nightly transport of packages from airport to airport, mostly via a hub. Express operators like DHL, TNT, UPS and FedEx, rely on night slots to arrive at the major markets in the early morning, which enables them to transport express cargo from shipper to recipient in only one day. However, also non-integrated freight operators value night time slots. In particular on the Asian market night time operations at an airport are a must, as the cargo leaves the Asian continent during the night to arrive in Europe the next morning. (Gardiner & Ison, 2008) Gardiner and Ison also showed that airlines would value an airport allowing night flights above one without night slots, whether the airlines uses them or not. (Gardiner & Ison, 2008)

3.4. Time-factors

Time can be very important for airlines, especially when the customer demands it. Congestion, airport delays, long customs clearance times and turnaround times can be a breaking point in the success of an airline and an airport as they can lengthen the lead-time of the transport chain. As products transported by air are often time-sensitive a longer lead time might not be accepted by airlines or their customer. Furthermore, when the airport can ensure short transit times, the shipper can reduce or even eliminate the need for warehouses and in times of emergencies get the shipment very fast to its destination. However, also contrasting results can be found in the literature. A survey of Scandinavian forwarders reveals for example that a short lead-time is only important for the forwarder when the end customer demands it. (Lumsden & Stefansson, 2007) Therefore, for some airlines short lead-times might be of less importance.

The importance of congestion and delays can also vary with the kind of carrier. For full-freight carriers, congestion is a primary factor in deciding against flying to a certain airport. (Gardiner & Ison, 2008) When transporting the goods by truck from a more remote airport to the destination takes less time than to transport them from another airport closer to the destination, the carrier will almost always choose the first one. Combination carriers on the other often find a certain level of congestion and delay acceptable to be able to benefit from the advantages of a major airport, like agglomeration advantages and collaboration with passenger flights. (Gardiner & Ison, 2008) Another disadvantage of congested airports where slots get scarce is that those airports are tempted to focus more on passenger flights as they generate extra income through indirect activities such as shops and restaurants. The most prominent example is Heathrow airport, where all-freighters were more and more pushed out of the airport. Even carriers that have their home base at Heathrow like British Airways World Cargo can only get full-freighter slots on an ad hoc basis. (Conway, 2004)

Congestion has a negative effect on airport attraction in two ways. Cargo airlines first of all might avoid the airport due to congestions and delays. However, there is some evidence in literature (see for example Ohashi et al. 2005) that also freight forwarders avoid large and congested airports. Therefore, cargo airlines might also avoid more congested airports, as their customers evade them.

The lead-time of cargo at an airport also depends on document requirements and customs administration. Murphy et al. (1989) for example found that 35% of airports and air cargo companies interviewed perceived the documentation as the major problem at airports. Furthermore, the inefficiency of customs can form a source of delay at the airport. Zhang (2003) reveals that in developing countries like China and other Asian countries the main function of customs is still the collection of revenues. As no pre-clearance of shipments is given and the clearance process remains a lot of paper work, the clearance of shipments is often delayed. However, as air freight shipments are often time-sensitive, the delays can be a reason for airlines not to operate at a specific airport/country and for forwarders to rather ship their goods from other airports or even other countries. In contrast, airports that provide reliable, timely customs clearance or even pre-clearance can build up a competitive advantage. (A. Zhang & Y. Zhang, 2002, p. 284) However, as a study by Yuan et al. (n.d.) shows, when airports are already very efficient in customs service as for example Hong Kong Chek Lap Kok or Singapore Changi Airport, further simplifications will only have a very limited effect on the air cargo volume. In other words, customs at an airport are expected by the cargo airlines to be efficient, but when the efficiency is further increased, it does not lead to more airlines servicing the airport or more cargo throughput of the airport.

Furthermore the duration of cargo handling influences the time goods spent at an airport. A survey of airports and air cargo companies revealed that about one third of the respondents judged the pickup and delivery times at airports as too long. (Murphy et al., 1989) A study about the airports in Northeast Asia on the other hand revealed that there seems to be very little variation in the duration of loading/unloading and customs. (Ohashi et al., 2005, p. 152)

3.5. Cost-factors

As airlines are private businesses with the ultimate goal of profit maximization, direct costs play an important role in all of the airlines decision. It can also be seen that forwarders as well as are very cost conscious which stimulates the airline even more to cut their costs. A study by Lumsden and Stefansson (2007) in which they conducted interviews with forwarders shows that smaller as well as larger forwarders put high priority on the price. However, the same study shows that forwarders would like to focus less on price and more on service, but are limited by the shippers.

One of the direct cost factors of airlines are the line-haul costs. Line-haul costs can be defined as flight time and the costs that are attached to it such as fuel and extra personnel costs. Gardiner & Ison (2008) for example view line-haul cost as an airport choice variable, especially when flying into a multiple airport region. Airlines themselves even refer to line-

haul costs as important when choosing an airport (see for example El Al Cargo (2008)). However, other studies such as Ohashi et al. (2005) conclude that line-haul costs are not significant for the choice of an airport, in particular of an air cargo transshipment airport.

As profit maximization is the ultimate goal of a cargo airline, cost minimization plays a major role in the strategies of cargo airlines. Even though, airport charges only account for a small part of the airlines costs, for European airlines this was 3.6% of total operating expenses for the first three quarters of 2009 (AEA, 2009), airports have to handle acceptable charges to be able to attract cargo airlines. Using a network simulation, Berechman & de Wit (1996, p. 259) found in a study about hub choice that a change in airport charges can have a significant change of popularity of an airport. Gardiner & Ison (2008) on the other hand state that airport user charges were empirically much less important than earlier research expected.

Additionally, airlines pay attention to the level of handling charges asked at the airports as well as to the fuel costs at the different airports. Many airports have disadvantages related to their fuel costs that might be higher than fuel costs at neighbouring airports. Dubai as upcoming cargo hub can be given as example for this problem as Dubai has little oil on its own and inefficient refineries which makes its fuel more expensive, and puts the airport at a disadvantage in comparison to the neighbouring airports of Sharjah and Abu Dhabi. (Hayman, 2009)

Finally, a last cost factor for airlines are the labour costs, whose importance can be seen in different studies. In a study about the air cargo supply chain Yuan et al (n.d.) point to a negative impact of labour cost on the volume on air cargo in the case of Hong Kong Chek Lap Kok airport and the same relationships for the outsourcing costs and air cargo volume at Hong Kong Chek Lap Kok and Singapore Changi. (Yuan et al., 2009) Furthermore, Hall (2002), Adler and Berechman (2001) and O'Connor (2001, p.169) confirmed that labour costs are a very important factor which affects the airport choice. However, O'Connor also states that labour costs are not the biggest concern to airlines.

3.6. Strategic factors

Next to cost and time factors also strategic factors play a role in the decision processes of airlines. Under strategic factors all factors are grouped that facilitate operations of airlines at an airport in the long run and are not necessarily taken due to cost, time and quality reasons.

First off all airlines have to decide whether they want to operate close to passenger airlines, competitors and partner airlines. Concerning the presence of passenger airlines at the airport a study about the alternative access and location of air cargo in the US revealed that it is sometimes very difficult for airlines to operate at an airport that does not have any international passenger traffic. (Hall, 2002) The reason behind it is that forwarders often expect a wide range of destinations offered by a cargo airline which only can be offered to them when cooperating with passenger airlines. However, this is especially true for

combination carriers as they often use all-freighters for routes with large demand and the space in their passenger airplanes for routes with less demand. For all-cargo carriers, on the other hand, the presence of other cargo operators can be essential, as to offer more destinations with to cooperation agreements.

Moreover, the presence of partner airlines decreases the risk that is associated with serving a new airport. This risk is also reduced by flying to the same airport as the competitor as the competitor cannot build up a competitive advantage in operating from another airport. (Gardiner & Ison, 2008) Furthermore, airlines in general like to follow successful airlines, whether they are partners or competitor as they expect to be part of the success. One example is Dubai Airport, which profits from the success of Emirates Airlines and therefore is able to attract other carriers. However, this can also has its disadvantages as competition will be fiercer when serving the same airport as the competition.

When thinking strategical, next to thinking about the competitive environment airlines also think about their future growth. For being able to be flexible and to alter their service with changing demand, sufficient future capacity is of great importance to airlines. A cargo airline that operates out of Heathrow for example would not be able to add more frequencies to or from Heathrow even when demand for those services increases. As all major airports in Europe are slot coordinated, it also limits the airlines in their short term flexibility to change their operations between or to a major airport in Europe. Furthermore, as a study by Dempsey and O'Connor (1997) reveals, the lack of capacity is also a disadvantage of many Asian-Pacific airports.

Furthermore, governments can have an influence on the attractiveness of airports for air cargo airlines with regulations and restrictions. In general governments should facilitate air transport operations, facilitate customs and give a stable regulatory environment concerning for example noise and night time restrictions. However, often government regulations put additional costs and delays on shipments. Therefore, to relax those measures is one way governments can contribute to cost and time-savings for airlines. Moreover, all-cargo airlines can experience severe discrimination at some airports due to government regulations. Heathrow and Gatwick airport can be taken as an example. A Traffic Distribution Rule which was put into action by the Secretary of State for Transport in 1991 forbids all-cargo flights at the two airports during peak hours. All-cargo carriers can ask for special permission for such flights, which is however, rarely given. This problem increases as peak hours at those airports are extended. From this discussion one can assume that Heathrow and Gatwick are not very attractive to all-cargo airlines. Contrary to expectations, cargo airlines still prefer Heathrow and Gatwick to for example Stansted, which means that other choice factors seem more important. (UK Competition Commission, 2009, p. A6(2)) Also labour relations can form a problem for airport attractiveness. In a survey of air cargo companies Murphy et al. (1989) shows that 35% of the survey respondents perceive labour relations as more than only a minor problem of airport operations.

However, government regulations not only hinder air transport, but in particular government subsidisations can make an airport become very attractive. In the air transport business this

is especially true for regional airports that want to attract low cost carriers but it is also true for increasing the attractiveness of cargo airports. Substantial subsidization goes even as far as making an airport attractive to airlines as a hub even when they otherwise would be very unlikely to develop a hub at a specific airport. (Huston & Butler, 1991)

Incentives, which can be financial as well as non-financial, though, can also come from the airports themselves. Airports can for example offer reductions in airport charges under specific conditions. As an extra incentive or in addition airports also often commit to marketing the airline together with the airport. With this methodology forwarders and shippers will be informed about the possibility to ship with a specific airline through a specific airport.

3.7. Airport Quality and the Perception of Airport Quality

Airport quality is often associated with the quality of airport services such as custom services and ground handling services which include loading, unloading, on-airport transport, warehousing and palletising of goods. Cargo airlines expect the services provided by the airport to be efficient, fast and adapted to the needs of air cargo. While the time and cost effects of those services were already discussed, a study by Murphy et al. (1989) showed that not only those aspects are important for airlines but also the quality of the handling. The study, a survey amongst air cargo companies, emphasizes amongst others the importance of a minimum of loss and damage of the cargo when being handled on the airport. This is especially important as goods transported by air are often of high value.

Nevertheless, not only the quality of general handling services as loading and unloading of the cargo is important for cargo airlines. As some cargo airlines operate in niche markets, they have the need for the provision of special services. Airlines that for example specialize in refrigerated goods need cooling facilities as well as other special handling. Furthermore, airlines that deal with live animals need a veterinary station with round-the-clock service for the animals. Other examples are airlines that deal with the transport of weapons. To be able to attract a cargo airline with this kind of cargo, stricter security measures must be ensured by the airport.

However, next to the experienced airport quality, also the perception of airport quality can play an important part in airport choice processes. The perception of airport quality can depend on the experience of the airport with cargo, whether cargo is a priority at the airport, the marketing of the airport and the airport reputation. Airports perceive an airport to have a better service quality if it has experience with cargo or if cargo is a priority at the airport.

Furthermore, as in other sectors, marketing can be an efficient tool to attract new customers. Theoretically, this can also be true for airports. Especially airlines that are not familiar with a particular airport or that operate for the first time to a specific geographical area can be influenced by marketing. In their campaigns the airport should then focus on those of the airport choice factors where they are strong in. However, Gardiner & Ison (2008) and Gardiner et al. (2005a) raise the question how effective airport marketing is empirically.

Marketing will probably be most effective with airlines that want to operate to/from a new region, where they did not operate from before. For all-cargo airlines that want to relocate in the same region, though, marketing might not have a large effect, as the advantages and disadvantages of alternative airports are already known to them.

Airport reputation, however, proved to be much more effective. When comparing the effect of financial incentives, airport reputation and airport advertisement, airport reputation was shown to be one of the most important choice factors. Airport marketing and incentives are often seen as only short-term advantages. Airlines however, also think in the long run, where a good airport reputation can be important as it decreases uncertainty. When an airport has experience and a good reputation concerning cargo, it can have a big advantage of its competitors. (Gardiner & Ison, 2008) However, at the European mainports airlines often have the feeling that they have disadvantages compared to passenger airlines such as lower priority handling and inferior facilities as well as drawbacks in slot allocation.

3.8. Other factors

Next to the factors presented in the previous sections, some factors were found in the literature which could not be included in one of the groupings.

Climate conditions for example play a role in the decision process of cargo airlines. Especially the absence of thick fog, heavy snow or strong winds is necessary to ensure continuous operations at the airport. (Dennis, 1994; Hall, 2002; Huston & Butler, 1991) One of the variables that originally lead DHL to develop their hub in Brussels were the good weather conditions with few fog and snow days.

Furthermore, labour availability can be a decisive factor in the airport choice. Sufficiently trained labour is necessary to ensure good airline and airport operations. DHL for example encountered problems after the move of their European hub to Leipzig in 2008. Technicians and ground handling staff was not sufficiently trained to handle the traffic brought by the company. (Birger, 2008)

At last, there is still a behavioural variable that airports have to consider. Sometimes personal preference and other human factors can influence the decision process of cargo airlines.

4. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

The analysis in the paper shows that air cargo indeed gained importance during the last decades. While air cargo has been growing even more than passenger transport, it also shows more volatility. Furthermore, during the last 40 years an increase in the share of all-cargo traffic could be found. The analysis also shows that all-cargo traffic and combi traffic behave in a different way and therefore should be studied separately. This will have implications for further research as due to those differences also the airport choice will differ between all-freighter operators and operators of combi-aircraft. However, to focus the study of airport choice only on all-cargo carriers would be too restricted, as the combination carriers form an important part of the air cargo environment. Therefore it is recommended to centre future research about airport choice around freighter operators but excluding the integrators due to their different business model. The term freighter operators can be defined as the all-cargo division of combination carriers together with the all-cargo carriers.

The section about airports revealed that the most important cargo airports of Europe can be found in the centre of the continent. Here a competitive environment for air cargo is formed due to the footloose nature of air cargo and the relative short distance between the airports.

In the third part of the paper, the airport choice process and the airport choice factors were analyzed. During the research it was found first off all, that there are not many recent studies revealing information about airport choice. Second, most of the information regarding airport choice can be found in literature about the best location for hub airports. A number of analyzes on the choice of air cargo hubs could be found (see for example Ohashi et al. 2005 and A. Zhang 2003), but also on the airport choices of passenger airlines (see for example Berechman & de Wit, 1996; Dennis, 1994; Huston & Butler, 1991). For further research it has to be taken into account, that there is a difference in analyzing the choices of passenger airports and cargo airports. The size of the catchment area for example for passenger airlines is much smaller, as passengers might not be willing to drive for 3 or 4 hours to the airport. Air cargo on the other hand can more easily be shipped by road to the airport, which is why the direct demand in the vicinity of an airport might be less important. Furthermore, passenger airlines might find night time restriction less of a problem as passengers prefer to depart/arrive during the daytime. Cargo airlines in contrast often rely on night flights to be able to timely deliver goods. This is especially true for express operators.

The factors of choosing a location for an airport hub or a non-hub airport can also be different. For an airport hub, the free capacity to accommodate eventual future growth as well as the presence of numerous partners might be of more importance than for the choice of non-hub airports. Furthermore for non-hub airports, it can be assumed that the location and the size of the catchment area are more decisive factors.

Studies that measure airport quality were also helpful for the identification of airport choice factors. However, most studies analyze the quality of passenger airports. Moreover, the studies look at airport quality from the passenger point of perspective (see for example Adler

& Golany 2001). Only one study could be identified where the evaluation is made from the airlines point of view. (N. Adler & Berechman, 2001)

The airport choice factors that could be identified were divided into seven groups: restrictions, market factors, cost factors, time factors, strategic factors, airport quality and perception of airport quality and other factors. While the factors were investigated separately in this study, also links can be found between the factors. The biggest link can be found between cost and time factors, as time factors such as airport delays also have an influence on the cost of the airline. The identification of the links between the factors will be a topic of future research.

Last but not least is this study only a first step into towards better understanding of the airport choice of air cargo operators and their relationship with the airports. In further research the choice factors have to be narrowed down by conducting exploratory interviews with cargo airlines. Moreover, these selected factors will be further assessed by conducting in-depth interviews using the conjoint method. This method was chosen as airlines have to make a trade-off between the different airport choice factors which will give a realistic idea about the ranking of the airport choice factors.

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