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TITLE OF PAPER

Assessing the features, key drivers and current trends in the air freight industry and their impact on the regional supply chain.

TOPIC AREAS

- *Trucking/air/rail economics and logistics, productivity, labor issues*
- *Local and regional environmental externalities: congestion, air quality, etc.*
- *Models for transportation, port, air, inter-modal operation, impact analysis*

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Assessing the features, key drivers and current trends in the air freight industry and their impact on the regional supply chain.

Keywords

AIR FREIGHT INDUSTRY, KEY DRIVERS, TRENDS, SUPPLY CHAIN, REGIONAL DISTRIBUTION, VERTICAL INTEGRATION, ALLIANCES, HUBS

Abstract summary

This paper deals with the assessment of the features, key drivers and trends in the air freight industry. Their contribution to the global and regional supply chain, and the impact on the regional distribution are being analyzed.

Abstract

The global air freight industry represents about 50 billion USD in direct revenue (2005) and substantially more in related supply chain services.

In the first part of this paper, the importance and forecast growth of the air freight industry are being illustrated. The impact on the entire regional supply chain at both ends is significant. Some potential major effects of this growth on regional distribution are being highlighted.

Secondly, the key drivers for the air freight industry are being identified and assessed. Economic growth, trade globalization and the rapid rise of the Asian markets are for instance macro-economic drivers that fuelled the growth of the last decade. Moreover, the declining yields of air freight pushed the supply of and demand for air cargo space. The continuous evolution of these key drivers makes it clear that the supply chain (freight and distribution) industry is poised for rapid growth. An overview of the potential impact of these key drivers on the regional distribution industry and infrastructure is being given.

In a third part of this paper, the recent trends in the air freight industry are being identified and assessed. Some of these, such as the rise of e-commerce, have a clear impact on regional distribution. Moreover, both horizontal and

increasingly vertical alliances in the cargo industry are being established, generating an increasingly consolidated route structure into major (cargo and passenger) hubs through alliances and mergers, each with a specific impact on the regional supply chain.

A fourth part takes a closer look at the impact of the above-described features, key drivers and trends on the regional supply chain. This paper takes a closer look at the impact of these large hubs on the regional supply chain, by creating a typology of airports.

Finally, an overall assessment is made and conclusions are drawn on the key drivers and trends that have the largest impact on regional distribution and which could be further analyzed in detail.

INTRODUCTION

The global air freight industry represents about 50 billion USD in direct revenue (2005) and substantially more in related supply chain services. Global export growth has outpaced production growth, global air freight growth has outpaced GDP growth, despite recessions and other set-backs to air transport (the outbreaks of the Asian and Russian currency crisis, SARS, the events following the 9/11 terrorist attack, ...).

In the first part of this paper, the importance and forecast growth of the air freight industry is being illustrated. World air cargo growth is forecast to be between 5.8% (Boeing) and 6% (Airbus) for the period 2008-2020, however regionally not equally distributed. The impact of this growth of both the air freight industry itself and its past and forecast growth on the global economy and the entire regional supply chain at both ends is significant. Some potential major effects of this growth on the regional distribution are being highlighted.

Secondly, the key drivers for the air freight industry are being identified and assessed. An overview of the potential impact of these key drivers on the regional distribution industry and infrastructure are being given.

In the third part of this paper, the recent trends in the air freight industry are being identified and assessed. Some of these, such as the rise of e-commerce, have a clear impact on regional distribution. Moreover, both horizontal and increasingly vertical alliances in the cargo industry are being established, generating an increasingly consolidated route structure into major (cargo and passenger) hubs through alliances and mergers, each with a specific impact on the regional supply chain.

A fourth part takes a closer look at the impact of the above-described features, key drivers and trends on the regional supply chain. Large hubs are strengthening their position, with a clear impact on local supply chain industry around these hubs, depending on whether these hubs are mainly integrator, consumption, production or transit hubs. This paper takes a closer look at the impact of these large hubs on the regional supply chain, by creating a typology.

Finally, an overall assessment is made and conclusions are drawn on the key drivers and trends that have the largest impact on regional distribution. Proposals for further research are given at the end of this paper.

1. The global air freight industry

The air freight industry has a number of distinct features that are important so as to understand the context and framework in which air freight carriers operate. A good understanding of this framework is a prerequisite to assess the identified key drivers and trends' impact on regional distribution.

Firstly, a feature of air cargo is that its business model differs significantly from the air passenger business model. However, as mentioned above, these models are often mixed in one single airline as about half of the world's air cargo is moved in the belly-hold of passenger aircraft. Therefore, the network planning and operations for half the capacity are dictated by demands of the passenger market (Kadar and Larew, 2004, p. 3-9).

A number of characteristics apply to both passenger and pure cargo airlines. The investment and operating costs for freighters and passenger aircraft are comparable. Both have to adhere to the same safety, security and operating standards for crew and equipment, and both are subject to the same route planning and governmental restrictions (airport slots, bilateral agreements, ...). However, a number of characteristics are distinctly different. Firstly, air freight works with the one-way philosophy, contrary to the return-flight philosophy of passenger airlines. Secondly, air freight is a heterogeneous good and comes in numerous shapes, weights, values, storage conditions, ... which is contrary to the 'one passenger equals one seat'-philosophy of passenger airlines. Thirdly, due to the heterogeneous nature of air cargo shipments, numerous different transport solutions must be available for air cargo, contrary to the 3 or 4-classes philosophy of passenger airlines. Fourthly, a limited number of forwarding agencies account for the majority of air cargo shipments, contrary to the high number of individual customers for passenger airlines. The buying power of the forwarding agencies is therefore significantly higher than the individual

passenger's buying power. Finally, unlike passenger airlines, cargo carriers do hardly ever own the end customer relationship.

A look at the top 10 of FTK¹ performed in international and domestic markets (IATA, 2008) shows that number 1 and 2 positions are occupied by integrators (Fed Ex and UPS). The other positions are all but one taken by combination (passenger and cargo) carriers. On position 9 Cargolux as the only full-cargo airline is positioned.

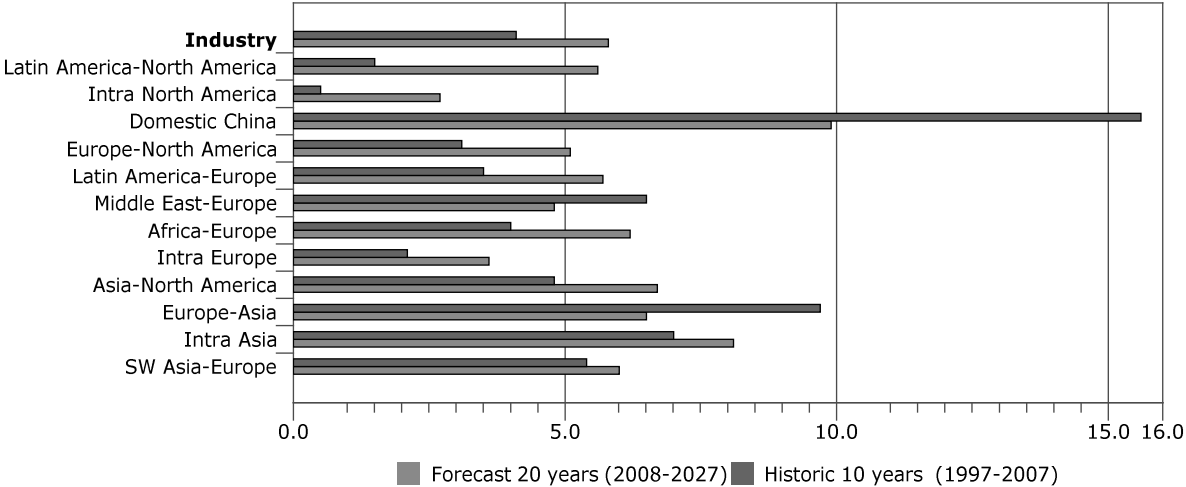
Table 1 : Top 10 airlines (domestic and international FTK's) – 2008

Rank	Airline	Millions FTK
1	Federal Express	15 122
2	UPS Airlines	10 977
3	Korean Air	8 890
4	Cathay Pacific Airways	8 245
5	Lufthansa	8 206
6	Singapore Airlines	7 486
7	Emirates	6 013
8	Air France	5 820
9	Cargolux	5 334
10	China Airlines	5 261

Source : IATA, World Air Statistics, 53rd edition, 2008

Secondly, one of the most striking features is the fact that the air freight industry is a high and steady growth industry. Measured in FTK², average industry growth was 4.1% the previous 10 years, and is forecast to be 5.8% over the 2008-2027 period (Boeing, 2008, p. 8). The figure below gives an overview of the past and projected growth of the air freight industry in and between a number of geographical areas. It is remarkable that most routes are projected to grow faster than they did the previous years, even in the already large and somewhat saturated intra-North American market. The highest projected growth is to be situated intra-Asia and on Asia-Europe and Asia-North America routes. Remarkable is also the declining, but still high and steady growth of air freight in domestic China, though still relatively small measured in total FTK.

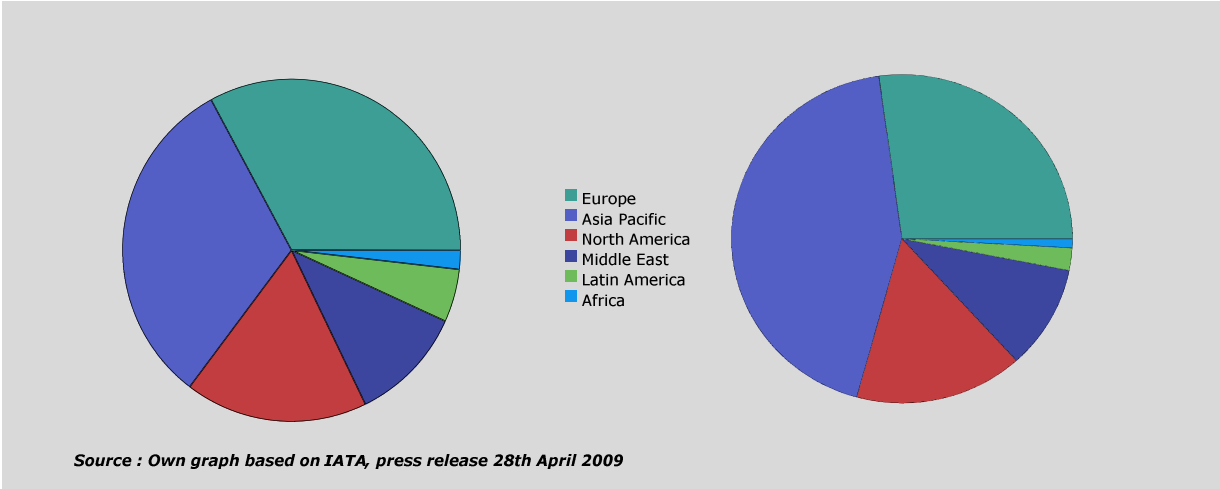
Figure 1 : Overview of past and projected growth of the air freight industry in percentage growth of FTK.



Source : Own graph based on Boeing, World Air Cargo forecast 2008-2009, p. 8

Thirdly, the air cargo industry operates on a global basis. The Asia-Pacific and Europe are the largest markets for both international air cargo and passengers flows. However, the US is still the most important air passenger and cargo market, as it has also an extensive domestic airline network. The figure below shows the relative market shares of geographical areas, based on internationally performed RPK³ en FTK.

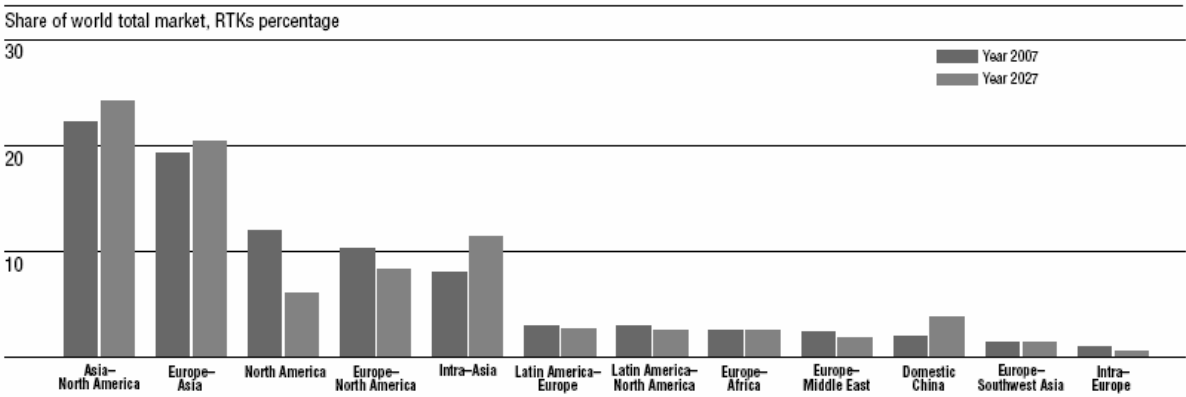
Figure 2 : Market shares (2008) by geographical area, based on internationally performed RPK (left) en FTK (right).



Source : Own graph based on IATA, press release 28th April 2009

Given the above-mentioned regionally differentiated growth in air cargo volumes over the next 20 years, route market shares will change accordingly.

Figure 3 : Share of world total market 2007 and 2027, RTKs percentage



Source : Boeing, World Air Cargo forecast, 2008, p. 21

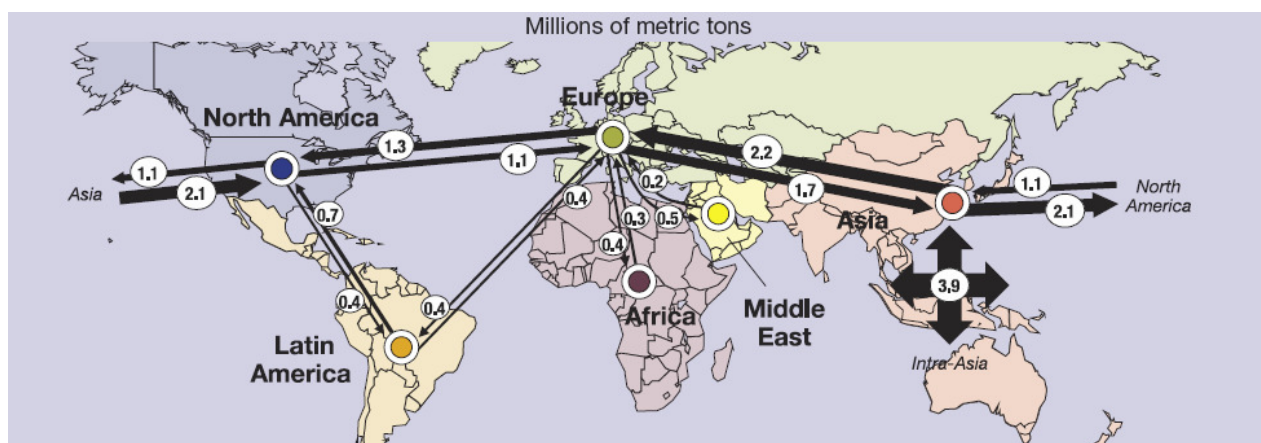
The above figure demonstrates that, while the Asia-Pacific markets will be gaining importance during the next 20 years, the Asia Pacific–North America and Europe–Asia Pacific routes remain by far the largest markets for air cargo, outgrowing easily the share of intra North-American and Europe–North American markets. Noteworthy is that air cargo is and remains in the future largely a Northern hemisphere phenomenon. 80% of air imports and exports are between countries above the equator. North America, Western Europe and East/South East Asia are the largest centers of air cargo usage (J. Kasarda, S. Appold and M. Mori, 2006, p. 6).

It is obvious that a strong growth in Asia will have a further knock-on effect on the ‘production hubs’ in Asia where goods are being centralized for export, and in ‘consumption hubs’ in Europe and North-America, where goods are being imported, customs cleared, stored and further regionally distributed into the hinterland. The concepts of ‘consumption hubs’ and ‘production hubs’ are analyzed at a later stage in this paper.

A fourth feature is that physical air trade flows are unbalanced. Air cargo is mainly used to transport high value goods, such as industrial and electronic equipment, fresh food and flowers, and pharmaceuticals. As the production and

consumption areas are unequally spread around the globe, this results in unbalanced trade flows. The figure below demonstrates that there is significantly more export than import from Asia to both Europe (2.2 versus 1.7 millions of metric tons) and North America (2.1 versus 1.1). There is slightly more import than export from South America to North America (0.7 versus 0.4), and from Europe to the Middle East (0.5 versus 0.2). Especially the very high imbalance between North America and Asia is remarkable.

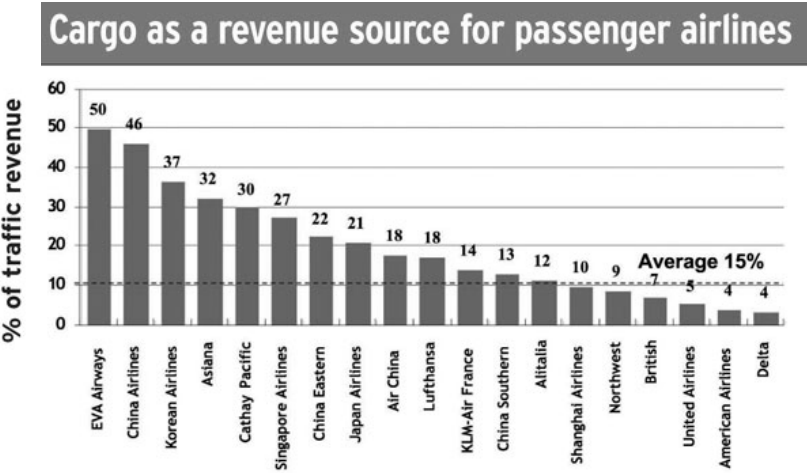
Figure 4 : Physical air trade flows (2005)



Source : Brian Clancy and David Hoppen, 'Steady climb', *American Shipper*, August 2006, p. 66.

A final feature described here is the strong influence of decisions made by the passenger side of the airline business on air cargo. Passenger airlines are important players in the air cargo industry, as half of total air cargo is being transported as belly-hold on board passenger airplanes. This also means that for at least half of the air cargo, the routing, frequency and capacity are being determined by the airlines' choice for passengers. However, importance of cargo revenue can differ significantly from one airline to another.

Figure 5 : Cargo as a revenue source for passenger airlines (2007)



Source : Airport Watch, 'Future predictions by Boeing of the global air freight market', International Freighting Weekly, 18th February 2008.

The above figure gives an overview of the cargo revenue as a percentage of total revenue for passenger airlines. Asian airlines are at the top of the scale, with freight accounting for 20% or more of the revenue. These airlines are obviously well positioned to grasp export flows originating from their home base. European airlines are in the middle ground with percentages between 7 (BA) and 18% (LH). Lufthansa was one of the first airlines to implement a strategy to build a separate business unit for cargo operations, Lufthansa Cargo, which gave focus, and helped to attract and commercialize cargo operations. Cargo contribution for North American carriers is minimal, between 4 and 5%. US carriers faced fierce competition from integrators since the 1980s, which is one of the reasons for the low importance of cargo revenue. Therefore, depending on the importance of cargo revenue for an airline, awareness of its place in the supply chain will increase. This can be an important element in the product and market strategy towards end-customers (mainly forwarders). Airlines with a high dependency on cargo revenue will tend to move towards vertical integration, and invest if and where appropriate in forwarders, own cargo facilities, distribution centers or even activities further down the regional supply chain. This explains why the top five airlines in the figure all have heavily invested in own cargo facilities, distribution centers and established partnerships with local trucking companies at their home base in respectively Taipei, Seoul and Hong Kong.

2. Industry key drivers

A good understanding of the industry key drivers is necessary to evaluate the impact of the trends in air freight and their impact on the supply chain, and hence on regional distribution. A number of key drivers for air cargo growth are being identified and explained below.

A first driver is GDP or trade volume growth. As general freight transport is the result of economic activity, traditionally the world demand for freight transport is related to world GDP. Significant research has been performed on the relation between the growth of air freight and GDP growth. Empirical studies (linear regression model by MDS Transmodal e.a., 2001) indicated that growth of air cargo is 3.1 times GDP growth. More sophisticated econometric models, as used by Boeing and Airbus, add transportation costs, exchange rates and relative prices to the air cargo demand function. The linear relationship seems to work rather well for total freight flows, but is less straightforward for air cargo (Kupfer, Meersman, Onghena and Van de Voorde, 2008, p. 12). This recent research by Kupfer *et al.* demonstrated that in international traffic where air cargo consists mainly of high value goods, the evolution of world air freight can better be explained by an indicator for world international trade in high value goods (Kupfer, Meersman, Onghena and Van de Voorde, 2008, p. 14). The elasticity of air freight with respect to merchandise exports is not significantly different from 1 neither in the long run equilibrium relation, nor in the short run adjustment. So a one percent change in world merchandise exports will result in a one percent change in air freight.

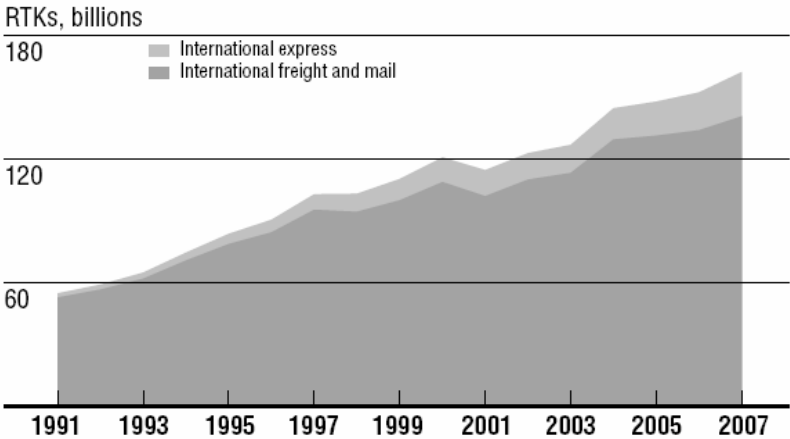
Depending on the source, worldwide GDP growth and international trade in high-value goods are set to increase between 3 and 5% on a yearly basis. Research (Y.-H. Chang and Y.-W. Chang, 2008) demonstrates that there is a long-run relationship between air cargo expansion and economic growth. The forecast GDP and merchandise volume growth will have an obvious knock-on effect on air cargo volume, and air cargo traffic departing from the origin and arriving at the destination airport. Impact on the local supply chain and regional distribution will be at least of the same order and weight..

Another, second key driver for the growth of air cargo is the globalization of trade and the subsequent need for increasingly complex supply chains (Air Cargo Management Group, 2006, p. 22). A number of factors can explain this. Firstly, the rise of global and regional trade agreements during the last decade (WTO, NAFTA, Mercosur, ASEAN, ...). In addition, the signature of 'open skies agreements' had a beneficial spin-off effect on cargo operations. Moreover, globally outsourced production has lengthened supply chains and increased their complexity. Concepts as lean manufacturing and JIT production have increased significantly the demand for time-definite services in the international market place.

Low fuel prices tend to be an important key driver for air cargo growth. Periods with low fuel prices (e.g. 1993-97) boost air cargo supply as it facilitates the entrance of new operators, often using older, cheaper in lease, but less fuel-efficient aircraft. The new entrants provide an additional cheap spot supply of capacity in the market, keeping a downward pressure on market prices. Moreover, during periods of lower fuel prices, older aircraft types (e.g. B747-200F and DC10-30F) remain longer in the fleet of operators, while newly built aircraft are being added in the airline's fleet.

Another important key driver is the growth of the express market. As the figure below demonstrates, international express traffic expanded from 4.1% in 1992 to 13.2% in 2007 as a proportion of total international cargo traffic, reflecting higher than average annual growth (Boeing, 2008, P. 5).

Figure 6 : International express versus freight and mail traffic volume



Source : Boeing, World Air Cargo Forecast 2008-2027, p. 5

Following a double-digit growth in the US in the 1970/1980s, express traffic continues to grow at more than twice the rate of the overall air freight market due to a number of factors. Firstly, both the rise of e-commerce and increasingly complex supply chains require more freight expeditions. Secondly, integrators have been the market innovators based on their expanding portfolio of value-added services, hence taking market share. However, the distinction between traditional express and general air cargo operators continues to blur due to the traditional air cargo operators expanding their time-definite offerings and value-added services. Moreover, in some cases (e.g. DHL-Polar Air Cargo-Danzas-Deutsche Post) express carriers, freight airlines, freight forwarders and postal authorities are consolidating either in a partnership or through vertically integrated M&A. A third factor explaining the growth of market share of express services is the simple fact that average international express shipment size grew from 2.7 kg in 1992 tot 5.7 kg in 2007 (Boeing, 2008), further bolstering the overall express component of international air freight traffic.

Another identified key driver is the declining yield, minus 1 percent point annually (Boeing 2008, p. 3), which creates additional demand for air cargo. The declining yield can be explained by a number of factors. Firstly, the increased usage of wide body aircraft for passenger transport generates additional (more economical) belly space. Secondly, technological innovations in more efficient new aircraft types and ramp handling/storage facilities generate a lower unit cost. Thirdly, increased competitive pricing due to the proliferation of web-based cargo portals (s.a. GF-X, CPS, Ezy Cargo,...) create a more transparent air cargo market. Finally, additional airlift capacity, especially in the Middle East, outsizes air cargo traffic growth. These factors will maintain their influence over the next decade, making the yield continue to decline annually.

Finally, as already highlighted in the previous chapter, the continued and high GDP growth (through export and import of merchandise) of Asian countries will be a main driver for intra-Asia and European/North American trade flows.

3. Trends in the air cargo industry

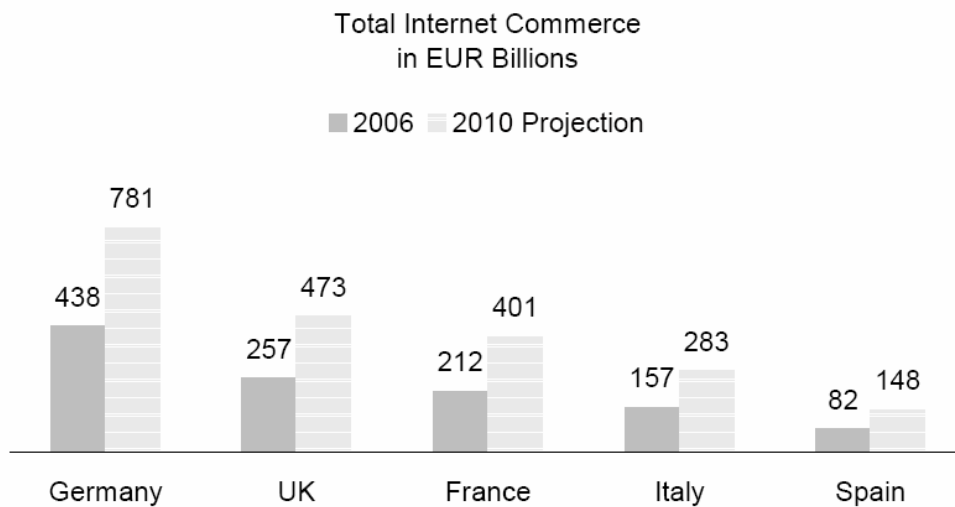
A number of trends in the air cargo industry are being identified in this chapter. Where appropriate, the potential impact on the regional supply chain is highlighted.

Air cargo was traditionally seen as a by-product of passenger transport. Pricing was based on marginal cost, and no separate cargo division took responsibility for sales and operations. The last decade this has changed considerably as air cargo is increasingly seen as a mature product, often differentiated through innovative marketing. Therefore, new marketing concepts for time-definite products, high value goods, cool chain products and live stock are being implemented.

These new products require a significantly different approach and organization for ramp handling, storage, customs clearance and regional distribution. Airports are increasingly important as a hub for regional distribution. Research done by H. Matsumoto demonstrated that large hubs are strengthening their position as international nodes for passengers and cargo (H. Matsumoto, 2004). A gravity model composed of GDP, population and distance showed that Tokyo, Hong Kong and Singapore in Asia, London, Paris, Frankfurt and Amsterdam in Europe and New York and Miami in the US are strengthening their positions. The reasons for this can be explained by a number of factors. Firstly, the attractiveness of a hub to certain industries that locates its production facility close to the hub. Secondly, the attractiveness of a large hub to freight forwarders, attracting on its turn further business. Thirdly, the rise of alliances is strengthening the dominant partner's hub through an alliance-based feeder system. Finally, the increased usage of large, more economical freighters between major hubs reinforces on its turn the origin and destination hub.

Another trend, with a major impact on regional distribution, is the increasing importance of e-commerce, which has a knock-on effect on demand for express delivery of physical goods, a large part of which is transported by air. The figure below shows the projected growth of e-commerce in a number of European countries. China and the Middle-East show a similar pattern. With the further internet penetration among population worldwide, other countries will follow suit.

Figure 7 : Total internet commerce in EUR Billions 2006-2010



Source : www.buyusa.gov/arkansas/ecommgerm1007.pdf , p. 1

The figure below gives an overview of the top 10 best-selling online goods in Germany in 2006. Five out of the ten (books, music CD's, fashion and shoes, computer hardware and DVD's) have to be physically delivered either at home or at local pick-up points.

Table 2 : Best-selling online goods in Germany in 2006

1. Books
2. Event Tickets
3. Plane and train tickets
4. Hotel Bookings
5. Music CD's
6. Fashion and shoes
7. Computer Hardware
8. Vacations, trips, ...
9. DVD's
10. Computer Software

Source : www.buyusa.gov/arkansas/ecommgerm1007.pdf

Moreover, the emergence of web-based cargo portals, similar to the introduction of CRS (e.g. Amadeus) in the 1980s and web-based booking engines in the 1990s (e.g. www.travelocity.com) initially, is a trend that re-inforces the downward pressure on yields, on its turn making air cargo more accessible for its

customers. These portals create a higher transparency on price and capacity, both for suppliers and customers. The most important web-based cargo portals are Global Freight Exchange (GF-X)³, Cargo Portal Services (CPS)⁴ and Ezycargo⁵.

A major trend currently featured in the cargo industry is the rapid rise of alliances, both horizontally and vertically. Following the horizontal alliances (Sky Team, One World, Star Alliance) initially created to exploit synergies on the passenger side of the business, these alliances increasingly stretch on the cargo side. Especially the WOW Cargo Alliance (Star Alliance) and Sky Team Cargo are building and integrating their networks around their major hubs.

A number of drivers for cargo alliances can be identified. Firstly, customer value is a main driver due to the availability of an increased and denser network, with a similar observed level of service and enhanced simplicity throughout the network. Secondly, cargo alliances create revenue and cost synergies due to the alignment of capacity in a combined network and fill-up of unused capacity. Cost synergies are relatively easily grasped by cost sharing in staff, offices, marketing, joint IT systems and handling. Moreover, increasing pressure on the market due to marginal pricing of substantial volumes of air cargo capacity, and the power and harsh competition of the integrators are reasons for all cargo carriers to solidify its market position by establishing vertical alliances.

According to the Air Cargo Management Group, a major task for airlines, forwarders and integrators in the coming years will be to define their desired participation (either through partnership, alliance or M&A) in the various logistics areas (Air Cargo Management Group, 2006, p. 5).

A final trend is the unprecedented growth of airlift capacity in the Middle Eastern region. Following the earlier success of Emirates, new entrants (e.g. Etihad and Qatar Airways) but also established carriers (e.g. Kuwait Airlines, Gulf Air, Royal Jordanian) in the Middle East add capacity in the passenger and cargo market. The reasons for their apparent success could be identified by a number of factors. Firstly, most airlines start from scratch, building a high-end business model, based on Singapore Airlines (s.a. Emirates, Etihad Airways), or a low-cost airline based on Southwest and Ryanair (s.a. Air Arabia, Air Bahrain). Secondly,

they use a superior marketing strategy to attract passengers and cargo through their hubs, by using the excellent geographical location between three continents (Europe, Asia and Africa), and the US within reach with A340-600 and B777-200ER. Through extensive use of the 'sixth freedom rights' (combination of third⁶ and fourth freedom⁷ rights), these airlines make full use of their geographical location. On the cargo side, the newly built Dubai Logistics City, with sea-air modal shift possibility, is a good example of this strategy. Moreover, most of the large airports are newly built and rather uncongested. Thirdly, the local airlines have access to cheap Middle Eastern and Asian labor work force, who on their turn generate a significant VFR⁸-customerbase. Western expertise is attracted through lucrative tax-free pay packages. Finally, they have easy access to the capital markets due to (semi-)governmental shareholdership, which makes financing large investments in equipment, facilities and supporting business possible.

4. Impact on the regional supply chain players

The continuous evolution of the above described key drivers and a Mc Kinsey study estimating that 20 percent of manufactured goods that are traded internationally today will rise to 80 percent in 2020, make it clear that the supply chain industry (freight transport and regional distribution) is poised for rapid growth. In 2005, scheduled air cargo service provided a 4.5 million tons weekly air cargo capacity at over 3.400 airports in 220 countries (J. Kasarda *et al.*, 2006). In addition integrators and charter companies provided additional capacity.

While examining data of top 25 cargo airports, measured in metric tons, and taking into account a number of features, key drivers and trends as described above, a typology of cities can be drawn in order to distinguish four types. Impact on the regional supply chain of each of these four types is varying.

A first type of airport is an 'integrator airport'. This airport is mainly used by integrators. An almost symbiotic relationship between integrator and airport exists. The airport is geographically centrally located, rather uncongested, and provides easy access by truck to the hinterland. A striking example of this

typology is number one ranked airport Memphis, also main hub and headquarters for FedEx. Louisville (no. 9 and home of UPS and DHL domestic US) and Indianapolis (no. 21 and second hub for FedEx) are the two other examples in the list. Three out of the 25 airports can be classified as 'integrator airport', handling about one fifth of the volume of these 25 airports. Growth of the two largest, Memphis and Louisville, was almost 5% in 2007. Impact on regional distribution is significant through the nature of the hub-and-spoke system and the product concept of integrators. Moreover, all shipments have to be physically picked up from origin and delivered to the end customer by a truck or van.

Research by C. V. Oster Jr. *et al.* demonstrated that the economic benefits such as employment in direct transportation and side activities as handling and storage of an integrator's air cargo hub facility on the local economy are significant (C.V. Oster Jr. *et al.*, 1997). Studied cases from Memphis (Fed Ex hub), Louisville (UPS hub) and Cincinnati (DHL hub) show, depending on the model, employment multipliers for air transportation investments around 2 (RIMS II- model developed by the Bureau of Economic Analysis, US) and in the range of 3.7 to 4.5 (regression coefficient from an econometric model methodology).

The previously mentioned unequal trade flows between geographical areas, due to unequal production and consumption patterns between these geographical areas can lead to the typology of 'consumption' and 'production' airports. 11 out of the top 25 airports can be classified as mainly production airports, taking care of almost half of the aggregate tonnage of the top 25 airports. Among these are highly ranked and fast growing airports such as Hong Kong (no. 2), Seoul (no. 4) and Shanghai (no 5). These airports are situated close to global production platforms, mainly in East Asia. Other 'production airports' in the top 25 list are all-but-one (Frankfurt) located in Asia. Main 'consumption airports' tend to be more on the European and North American side. At least 10 of the 25 airports can be classified as mainly consumption airports, and are situated in well established consumer centers of the world. Paris CDG, Amsterdam, Los Angeles, New York and Chicago are typical examples. Two of the 25 airports can be classified as both production and consumption hubs (Tokyo, Frankfurt).

Figure 8 : Top 25 airports, measured by metric tons (2007)

WORLD RANK	AIRPORT	COUNTRY	TONNAGE	PERCENT (%) CHANGE	COMMENTS
1	MEMPHIS (MEM)	United States	3,840,574	4.0	The main hub and headquarters for FedEx Express is also a regional passenger hub for Northwest Airlines
2	HONG KONG (HKG)	China	3,772,673	4.5	Third cargo terminal to be finished in 2011; an Asia hub for DHL and main hub for Cathay Pacific/Dragonair.
3	ANCHORAGE (ANC)	United States	2,826,499	0.6	Figures include transit cargo; a major trans-Pacific transit point for carriers including FedEx, UPS, Northwest
4	SEOUL INCHEON (ICN)	South Korea	2,555,582	9.4	Hub for Korean Air; centerpiece of government plan to foster Asia logistics business
5	SHANGHAI PUDONG (PVG)	China	2,494,808	15.5	Secondary hub for freighter operator Great Wall Airlines China Eastern hub; UPS China base
6	PARIS DE GAULLE (CDG)	France	2,297,896	7.8	Main hub for Air France; a European hub for FedEx and La Poste
7	TOKYO NARITA (NRT)	Japan	2,252,654	(1.2)	Hub for Japan Airlines and gateway for Northwest Airlines Cargo
8	FRANKFURT (FRA)	Germany	2,169,025	1.9	Hub for Lufthansa Cargo; manager Fraport also runs nearby Frankfurt Hahn Airport; Main air hub for UPS
9	LOUISVILLE (SDF)	United States	2,078,290	4.8	Main air hub for UPS, now taking on DHL Express domestic U.S. traffic
10	MIAMI (MIA)	United States	1,922,982	5.0	Main gateway for U.S.-Latin America traffic; a regional hub for American Airlines
11	SINGAPORE (SIN)	Singapore	1,918,159	(0.7)	Home to Singapore Airlines; Swissport opened cargo terminal in 2005 as third freight handler at Singapore Changi
12	LOS ANGELES (LAX)	United States	1,877,876	(1.5)	Largest U.S. trans-Pacific gateway; FedEx has largest single share of cargo, all domestic; Korean Air is largest international carrier
13	DUBAI (DXB)	United Arab Emirates	1,668,506	11.0	Emirates base; Dubai Cargo Village being expanded
14	AMSTERDAM SCHIPHOL (AMS)	Netherlands	1,651,385	5.4	Hub for KLM; AirBridge Cargo, Jade Cargo; hosting TIACA Air Cargo Forum in 2010
15	TAPEI (TPE)	Taiwan	1,605,681	(5.5)	Base for EVA Airways and China Airlines M
16	NEW YORK KENNEDY (JFK)	United States	1,595,577	(2.8)	The largest U.S. trans-Atlantic gateway; American Airlines holds more than 10 percent of cargo market, FedEx 9 percent.
17	CHICAGO O'HARE (ORD)	United States	1,524,419	(2.2)	Main hub for United Airlines; controversial proposal to add third Chicago region airport under consideration
18	LONDON HEATHROW (LHR)	United Kingdom	1,395,909	3.9	British Airways hub
19	BANGKOK (BKK)	Thailand	1,220,001	3.2	Thai Airways hub; the new Bangkok Suvarnabhumi International Airport replaces Don Muang airport
20	BEIJING (PEK)	China	1,191,048	15.8	Main base for freighter operator Great Wall Airlines, and for Air China Cargo
21	INDIANAPOLIS (IND)	United States	1,056,517	1.2	The second-largest FedEx Express U.S. hub
22	NEWARK (EWR)	United States	943,174	(2.7)	Continental Airlines hub; FedEx regional hub
23	LUXEMBOURG (LUX)	Luxembourg	856,740	14.0	Cargolux hub
24	TOKYO HANEDA (HND)	Japan	851,551	1.7	Mainly domestic but fourth runway in 2009 to add international Asia flights
25	OSAKA (KIX)	Japan	845,996	0.5	Freighters from FedEx, UPS and NCA;

Source : Air Cargo World, Feature Focus, TOP 50 Airports, July 2008

H. Matsumoto completed research on international urban systems and passenger/cargo flows. He suggested that a large hub airport serving many destinations with frequent flights has the potential of exerting a major impact on adjacent urban areas (Matsumoto, 2004, p. 241). The results reveal that Tokyo, Hong Kong and Singapore in Asia, London, Paris, Frankfurt and Amsterdam in Europe and New York and Miami in the US are strengthening their positions as international hubs. These hubs were classified above in respectively production and consumption hubs.

A final type of airport can be classified as 'transfer airport'. Anchorage (no. 3) as a major trans-Pacific transfer point, Miami (no. 10) as main transfer point between North and South America, and Dubai (no. 13) as a main hub for transfer traffic between Europe, Asia and Africa are three out of the top 25 airports which main existence depends on transfer traffic. In line with the projected growth of air traffic in the respective geographical areas, Miami and Dubai are showing healthy growth figures of 5 and 11% percent respectively. Although no empirical research exists on this topic, it is obvious that transfer traffic induces a lesser impact on the regional supply chain, as activities tend to be limited to handling and storage.

Conclusion

Air cargo is one of the major means by which the globalized world moves its valuable consumption goods and manufacturing components. Through its role in the supply chain, it facilitates worldwide economies and their international trade. It has also been an effective way of connecting mainly Asian labor with Western European and North American consumption markets.

With time-definite international transactions in an increasingly globalized and complex supply chain, enhanced production flexibility and speed characterizing much of the new economy, air cargo will undoubtedly play an increasingly vital role in the global economy. In this paper, a number of features, key drivers and trends associated with air cargo transport have been assessed. Most important eye catchers in this matter are its consistent impressive past and future

projected growth path, the ongoing innovations and the level of consolidation and integration, which demonstrates the stage of maturity and professionalism the air cargo industry has reached.

Taking into account a number of features, key drivers and trends as described in this paper, a typology of airport cities, listed in the top 25 world cargo airports, can be drawn in order to distinguish four types: integrators, production, consumption and transfer hubs. Impact on the regional supply chain players of each of these four types is varying.

Further research could be done on fine-tuning the typology of these airports, on the impact of the evolution of these airports on employment in handling, storage, regional distribution and on traffic flows to and from the airport induced from the air cargo development. Moreover, limited empirical research exists on the rationale behind the location of these hubs.

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¹ **FTK** Kilometer is a measure to express cargo volumes transported. 1 FTK is 1 metric ton of freight transported over the distance of 1 kilometer

² **RPK** Revenue Passenger Kilometer is a measure to express passenger volumes transported. 1 RPK is 1 paying passenger transported over the distance of 1 kilometer.

³ **GF-X** (Global Freight Exchange) was originally set up as an automated booking tool in 2002 by American Airlines, Deutsche Post, and Panalpina. Later on an equity stake was acquired by Kühne and Nagel. A large number of mainly European and Middle-Eastern airlines and forwarders joined GF-X. It has been sold to Descartes in 2007 for 5.4 million USD, who has integrated it in its Global Logistics Network (GLN), a trace-and-tracking tool that integrates data from airlines, forwarders and trucking providers. It now searches, books and tracks shipments online over 90 airlines, 30 ocean carriers and 1600 truck companies.

⁴ **CPS** (Cargo Portal Services) is owned by UNISYS and claims to be the first full-service internet portal for the air cargo industry offering neutral multi-carrier booking, and online booking with agreed rates and allotments. Most large North-American airlines are partner of CPS (Delta, Northwest, American Airlines, United Airlines), though the Lufthansa and Air France/KLM group are using it as well to obtain a higher market penetration.

⁵ **Ezycargo's** membership is entirely based in the Asia Pacific region. Ezycargo is a host-to-host system and does not show capacity availability or pricing centrally. Airlines of this region tend to embrace the one-stop electronic interfaces more, largely because Asian carriers have been pushing for freight forwarder co-operation more than their US and European counterparts.

⁶ **Third freedom rights** are the rights used in aviation law to indicate the right to carry passengers or cargo from one's own country to another.

⁷ **Fourth freedom rights** are the rights used in aviation law to carry passengers or cargo from another country to one's own.

⁸ **VFR traffic** is the incoming and outgoing traffic generated by and to Visitors, Friends and Relatives.