CHAPTER 1

AIR CARGO – AN HISTORICAL PERSPECTIVE
# CHAPTER 1 - AN HISTORICAL PERSPECTIVE

## TABLE OF CONTENTS

1. AIR FREIGHT  
   1.1 What is Air Freight? ................................................................. 3
   1.2 History of Air Cargo .................................................................. 3

2. COMPETITIVE ADVANTAGE OF AIR CARGO  
   2.1 Traditional Values ................................................................. 4

3. MODAL CHOICE  
   3.1 Modal Choice .......................................................................... 7
   3.2 Competition to Air Cargo .......................................................... 9
   3.3 Air Cargo Business Models ....................................................... 9
   3.4 Current Air Cargo Paradigms ................................................... 10
   3.5 Business Models ..................................................................... 11
   3.6 Modal Shifts ............................................................................ 11
   3.7 Alliances .................................................................................. 12
   3.8 Online verses Brick and Mortar .............................................. 12
   3.9 Decisions and control .............................................................. 12
   3.10 Regulatory ............................................................................. 12
   3.11 Environmental ....................................................................... 12
   3.12 Freedom Rights .................................................................... 13
   3.14 Air Cargo Trends ................................................................... 13
   3.15 Air Cargo Future Perspective ............................................... 13
   3.16 Aircraft and Freighter Fleets ................................................. 14
   3.17 New Aircraft Technology ..................................................... 15
   3.18 Cargo Airships .................................................................... 16
   3.19 Bio-Fuels .............................................................................. 17
   3.20 Airports of the Future ........................................................... 17
   3.21 E-Freight .............................................................................. 19
   3.22 RFID and Tracking Cargo into the Future ............................ 20
1. AIR FREIGHT

1.1 What is Air Freight?

What is air freight? Specifically, what types of goods have a greater propensity to travel by air rather than much cheaper surface modes of transport? In 2012, cargo revenue made up approximately 15% of total air traffic revenue\(^1\). Air freight accounts for about 1.5 percent of total freight by weight transported worldwide, but some 30 percent of total freight value. From this statistic, it is tempting to say that only high-value commodities move by air, and that relatively low-value products are inherently more likely to travel by truck, train, or ship. Indeed, many analysts focus on a value-per-pound component when discussing the air cargo prospects for a particular product or geographic market. However, is there more to it?

Various academic papers published since the early 1980s have identified and analyzed other factors which have an equal, if not greater, influence over whether a particular commodity is transported by air or by a less expensive, slower and often less reliable surface mode of transportation. Most industry professionals and members of the academic community agree upon a number of factors that are believed to have the broadest and most significant influence on the “air-eligibility” of specific commodities. The historical relationship between a value per pound and air penetration rates, the percentage of total weight moving by air, is an important factor. However, the relationship is changing, and may break down, as non-value factors become more significant determinants of modal choice. The changing relationship is important because it affects everything from macro-level air cargo demand forecasts to the micro-level design and pricing of specific freight transportation products. Each transport mode offers different costs and benefits. This document explores how shippers weigh the perceived benefits of air cargo against the cost, and how changing perceptions are increasingly diverting some low-value commodities to air transportation. To establish the proper context for this chapter, an examination of how and why shippers chose modes of transportation before assessing the most important non-value factors governing air-eligibility must be undertaken.

1.2 History of Air Cargo\(^2\)

Even before the aircraft, mail was moved by balloons, dirigibles and carrier pigeons. The first cargo moved by aircraft occurred on 7 November 1910 when a few bolts of silk were transported by air from Dayton to Columbus, Ohio. The following year in 1911 experimentation with the movement of post was stated, and by 1914 regular air service began in the United States. In Germany, the first official air mail flight occurred in 1912. However, it was not until 1925 before a comprehensive airmail service was available in the U.S. On October 7, 1925 the first five Contract Airmail (CAM) routes were issued by the U.S. Postal service to fly airmail between designated points. For example, CAM 1 flew the New York to Boston route and was managed by Juan Trippe, who would later start Pan American Airways. By 1931 85% of airline revenue was from domestic airmail contracts, with 14.8% from passenger service and only 0.2% from freight. If it had not been for the postal service CAM routes, the development of the U.S. commercial aviation section would be been hampered.

World War II caused a rapid expansion of the aviation industry and for the first time, large scale movements of freight were carried out to support the war effort. For example, in support of the Nationalist Chinese over 650,000 tons of cargo was transported over The Hump between India and southern China

\(^1\) From Boeing World Air Cargo Forecast 2012-2013.
\(^2\) Parts of this section taken from the book Air Cargo Operations by Robert Walton, 2011. Used by permission.
between 1942 and 1945. Later, in the 1948 and 1949 timeframe, the largest airlift in history occurred to support the blockaded city of Berlin.

In the early 1970’s the door-to-door express package services came into being. Dalsey, Hillblom and Lynn started DHL in 1969, and Fred Smith started Federal Express in 1971. The leadership role of Fred Smith in building FedEx is a classic study of entrepreneurship.

The era of the wide-bodied jets started in 1970 when the first Boeing 747 entered service. This was the first time in history that the aviation industry chose size over speed to increase performance. Soon afterwards, Douglas and Lockheed started production of three engine wide-bodied aircraft, the Douglas DC-10 and Lockheed L-1011. In the beginning only the passenger market was serviced by these new wide-bodied aircraft until Lufthansa flew the first Boeing 747 freighter in April 1972 between Frankfurt and New York. The much larger wide-body increased the volumes carried by narrow body aircraft by a factor of 2.7³.

By 2012, there were 1738 freighters in operation worldwide. Thirty-seven percent of these were large wide-body (>80 tons) aircraft, 36% were medium wide-bodied aircraft (40 to 80 tons) and 27% were standard bodies with carrying capacities of less than 45 tons. Boeing projects the demand for the world freighter fleet to increase to almost 3,200 airplanes by 2031⁴.

2. COMPETITIVE ADVANTAGE OF AIR CARGO

2.1 Traditional Values

Why is there a relationship between a product's value and its propensity to be shipped by air transportation? There is no single answer, but it is safe to say that relatively high-value commodities tend to go by air, despite the much higher cost, for one or several of the following reasons:

Small shipment size

Due to their cost, high-value commodities tend to move in relatively small lot sizes, which make them suitable for air transport. To use an extreme example, no one buys gold in quantities sufficient to fill a twenty-foot sea container. While less costly than gold, electronics, precision instruments, sophisticated industrial machinery and other high-value commodities also tend to be compact.

Security

High value commodities, by definition, require more security from loss, damage or theft than lower-value goods. Aircraft generally offer not only the fastest but also the most secure way to move cargo from point to point.

Cost of Capital

High-value commodities consume large amounts of capital and impose high interest costs on their owners. Thus the time-savings achieved through air cargo are worth more when high-value commodities are involved. Collectively, these value-driven factors are at work, although their impact on transport decisions depends on changing shipper perceptions of their relative importance. Moreover, other factors

³ Source: The History of Air Cargo and Airmail from the 18th Century by Camille Allaz, 2004
⁴ From Boeing World Air Cargo Forecast 2012-2013.
unrelated to commodity value increasingly influence shippers' modal selection process. To better understand each factor, and how it interacts with the others, it is necessary to first explore how transportation modes are selected and recognize, in general, that shippers do not care about transportation mode. They care about the consignment reaching its intended destination, on time and in good condition, and the cost of the transportation.

**Inventory cost**

Because air cargo operations can offer a shipper the benefit of speedy, constant resupply, inventory levels can be reduced. This element of speed allows a producer to ship products to their customers just in time instead of having to operate large warehousing facilities. By reducing inventory levels a firm can free up more capital, reduce inventory holding costs, and reduce obsolescence cost.

In summary, air cargo provides the benefits of speed, reliability, security, and reduction of inventory cost.

### 3. DEMAND

Sir Richard Branson, founder of Virgin Atlantic Airways, summed up the aviation business by stating that “if you want to be a millionaire, start with a billion dollars and open an airline. Soon enough you will be a millionaire.”

The all-cargo airline industry is comprised of a small group of airline companies that do not carry passengers, but instead focus solely on moving cargo by air. Air transport is one of the five modes of transportation (highway, rail, maritime, and pipeline being the others) used for the global movement of goods. While all modes can move the same commodities (except pipeline), maritime and air are the only two modes that can support intercontinental freight movement. Maritime transport offers low-cost movement of goods, whereas airfreight offers the benefit of speed, reliability, and security. Changes in world air cargo traffic are strongly linked with changes in the world gross domestic product (GDP); therefore, as the world economy expands, so does the demand for air transport. According to the Boeing 2012 annual forecast, between 1987 and 1997, worldwide demand for the movement of air cargo grew at an average rate of 7.1% annually; however, this growth slowed after September 11, 2001, to an annual growth rate of 4.1%. After the terrorist attacks that happened in the U.S. on September 11, 2001, the price of fuel increased, driving up the cost of air shipments and caused companies to migrate toward less expensive road, rail, and maritime transport. The high costs of providing air transport and the weak economy have pushed many all-cargo airlines to the brink of bankruptcy.

The aviation industry is capital intensive and highly leveraged and the need to buy and operate expensive aircraft (US$300 million for a new B747-8 Freighter) requires extensive financing. The airline industry's debt load exceeds most industry averages; in fact, the ratio of long-term debt to total capitalization has been estimated at more than 50 percent. Because of high capitalization of the aviation industry the financial health of the industry is highly correlated with the global economy. As debt loads increase from the purchase of expensive aircraft and high operating expenses, so does the likelihood of financial distress. Since the aviation industry is highly related to economic expansion, it is not surprising that the industry also suffers when the economy stalls. Economic fluctuation affects air cargo carriers in an amplified way, so, as the world's economy expands so does the demand for the moment of air cargo. Also, in recent years the increase in fuel prices has put additional financial pressure on the aviation industry.

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5 Parts of this section taken from the book Air Cargo Operations by Robert Walton, 2011. Used by permission.
Like the passenger airline industry, the air cargo industry is very sensitive to the national and world economies. An expanding economy leads to increased production and therefore an increase in demand for air cargo. World air cargo demand tends to drop off very quickly as the world economy begins to stall, but then tends to be an early indicator of economic recovery, since demand increases early in the economic upturn. This trend can be seen in figure 1.1.

A down turning economy can quickly result in an overcapacity in the cargo airlines, and the inverse, an upturning economy, can quickly leave the industry with too little capacity. Obtaining a new aircraft has a long lead-time, so airline companies’ attempt to time the purchase of aircraft to coincide with a predicted future upturn in the economy. If management gets it right, then the new aircraft arrive in time to meet the increase in demand as the economy heats up; but if the timing is wrong management is left with a very expensive asset that cannot be fully utilized. For example, Cargolux was to receive their first new Boeing 747-8 freighter aircraft in 2009. At that time there was overcapacity in the industry, not a good time to be adding capacity; however due to production delays Cargolux did not receive their first B747-8F until the fall of 2011. Because of under capacity in the industry in 2010, to meet demand, Cargolux had to lease two aircraft that were older and more costly to operate.

One of the reasons why the aviation industry has financial difficulties and weak profit margins is that demand fluctuates constantly but the supply is relatively fixed, this is true for both passenger and cargo airlines. This fluctuation in demand makes it hard to optimize the use of available capacity effectively. Yield or revenue management is the process the aviation industry uses in an attempt to level out the demand fluctuations. The next section of this chapter reviews the fleet management procedures used by airlines when deciding on what type of aircraft to use.

The air cargo industry differs from the passenger industry in that cargo is normally not booked roundtrip, so cargo flow is unpaired and often unbalanced, for example, with more demand for cargo moving in one direction but not the other. This situation often requires cargo airlines to fly less than full aircraft on some
routes. For example, an airline may have to fly a less than full aircraft to China to return with a full aircraft from China. Unlike passenger aircraft for which there is a fixed capacity (i.e., seats), cargo is multi-dimensional (volume and weight), so the load must be balanced and optimized by mixing cargo of different volumes and weights to maximize the load. Optimization of cargo loads require in-depth planning, but in theory, some space can be sold twice, e.g., to one customer with big, light cargo and another with heavy, high-density cargo. All-cargo airlines also differ from passenger airlines in routing possibilities. Cargo does not have to fly a direct route; the only constraint is the required delivery time.

Revenue management planning in the air cargo business is much more difficult than in the passenger airline industry. Passenger airlines have a vast amount of historical booking data they use to determine demand and pricing on various routes, whereas the cargo airlines lack detailed historical booking data. Because of the differences between the supply and demand of passenger and air cargo airlines, revenue management for cargo is more complex than for the passenger business. The capacity supply issues are: uncertainty of available capacity, multi-dimensional capacity, heterogeneous production platforms, large number of routing possibilities, large number of restrictions, and multi-segment flights. On the other hand, market demand issues include stowage loss, unequal trade lanes, short booking periods, volatile business, continuous show-up rates, market structure, and data shortcomings. For cargo shipments, the amount of cargo is volatile and uncertain until departure time; that is, the weight or volume may fluctuate, taking up more or less room on the aircraft, unlike passenger airlines in which a seat is a seat. Another issue is market structure. Air cargo airlines typically only provide capacity to a limited number of customers, such as freight forwarders, who make most of the bookings. Therefore, the loss of one booking can have a large impact on the revenue for that flight.

Seasonal fluctuation can also affect air cargo operations in the short term by leading to under-capacity in the high season, e.g. the months leading up to the winter holidays, or overcapacity in the low season, e.g., after the holiday rush.

### 3.1 Modal Choice

There are a number of academic publications on the subject of modal choice. Unsurprisingly, there is also a great deal of disagreement within the literature. However, most of the academic research incorporates some form of a total distribution cost (TDC) framework, in an effort to quantify the effect of transportation decisions on the total costs of manufacturing and distributing a product. The academics argue that companies can maximize their profitability by correctly quantifying and then managing their total distribution costs, as opposed to focusing only on certain highly visible components of TDC, such as transportation expense. Accordingly, this section will present the most important factors governing modal choice, and discuss how each factor operates and interacts with the others. Generally, the following factors as have the most influence on modal selection:

#### Value

High-value products have a greater propensity to be shipped by air.

#### Physical Characteristics

Extremely bulky or low-density products are not suitable for air transport, either because they cannot be accommodated on an aircraft or the resulting cost per pound would be uneconomically high.

#### Perishability


The perishability of a product is an important determinant of the choice of transport mode. Products can "perish" in terms of economic utility (value), physical degradation, or both. An example of economic perishability would be Christmas cards, which have a small retail-selling window. On December 26, unsold Christmas cards have little value to consumers until the following year, even though the physical characteristics of the cards are unchanged. An example of physical perishability would be strawberries, which spoil (even with refrigeration) within two weeks of harvesting. Thus strawberries would not survive the ocean voyage from California to Japan, leaving air cargo as the only viable transport option. The same is true for fresh seafood and meat. Some products suffer both types of perishability: consider red roses, which are in tremendous demand (at premium prices) during the week before Valentine's Day. Even with pre-cooling and other preservation techniques, roses and other cut flowers cannot be stored long-term, and therefore must be transported swiftly from growers to consumers.

Demand predictability

The more predictable the demand for a particular product, the more advance planning can be done and the more flexibility a shipper has to ship via less expensive, but slower, surface modes. Products with less predictable demand characteristics afford less flexibility in transportation decisions. If shippers want to avoid lost selling opportunities (called "stock-outs"), they must either expand inventories, which increases carrying costs and potentially exposes the company to write-downs, or utilize air cargo to respond more quickly to demand surges. An example of a product with extremely predictable demand is infant formula, which (for obvious reasons) does not experience significant seasonal or cyclical fluctuations in demand. An example of a product with extremely unpredictable demand is children's toys: will the "reptile-invaders-from-Mars" toy be a top seller during the Christmas season? If so, the manufacturer has to swiftly manufacture and distribute the products to take advantage of the fad to increase sales.

Geographic market transportation factors

A number of factors unique to particular geographic markets can significantly impact the viability of different transport options. Geographic market characteristics which could affect the choice of transportation mode include: lack of modern ground transportation infrastructure; poor security controls; long customs and brokerage cycles; harsh or unusual terrain; and distance from seaports, airports or railheads. The existence of any one or a combination of these factors limits transport options and can therefore materially affect modal choice. For example, many interior cities in the former Soviet Union are not efficiently served by road or rail, leaving air freight as the only viable option. Also, markets with sharp directional imbalances in air cargo demand can have unique and sustained airlift pricing distortions. Consider, for example, the fact that westbound traffic and yields in most transpacific markets are multiples of eastbound volumes and rates. In other words, carriers fly from the U.S. to Asia in order to take advantage of the lucrative return trip. Accordingly, the airlines offer steep discounts on the positioning flights. Such "backhaul" pricing can upgrade commodities which otherwise would not move by air.

Based on the above factors, many academics have identified certain commodities as being "captives" of a particular mode. For example, it would be impossible to sell California strawberries in Japan without using air freight, so strawberries are considered "air captive" commodities, along with other highly perishable products, such as seafood, fashion garments, and cut flowers. Other commodities are considered "sea captive" --that is, their only economically viable mode of transport is by ocean. Bulk commodities, such as lumber, grains and oil, fall into this category. Most freight traffic is not "captive" to one mode or the other, but rather could use either air or surface depending on the cost-speed-reliability-security tradeoffs discussed earlier. Of course, not all of these factors can be quantified. Moreover, individual shipper choices are not always grounded in quantitative analysis of alternative transportation products. But if shippers attempt to quantify the tradeoffs between different transport options, and if the commodities are
not captive to a particular mode, then a total distribution cost analysis can be a powerful decision-making tool.

3.2 Competition to Air Cargo

The movement of cargo for distances under 800 miles tends to be dominated by highway transportation. For distances greater than 800 miles rail, pipeline, and maritime shipping are most often used for low value or bulky goods. High-value goods that require movement greater than 800 miles tend be moved by air. However, with increasing fuel prices after the turn of the millennium a modal shift from air to surface transportation such as rail and maritime has occurred. Rail and maritime transportation offers the benefits of low-cost whereas air transportation provides the benefit of speed reliability and security. During the global economic downturn in 2008 all major trade lanes were affected and all modes of transportation experienced declines in freight transport. However, by mid-2010 as the global economy began to recover demand for all modes of transportation increased. During economic upturns and down swings airfreight tends to lead the economic indicators. That is as the economy starts to decline the demand for air freight drops quickly and in reverse just before an upswing in economic recovery the demand for air cargo increases as companies attempt to optimize their supply chains and replenish depleted inventories.

3.3 Air Cargo Business Models

There are several business models used in the air cargo industry: the predominant ones include the all-cargo carriers, the integrators (operators that deliver cargo from point to point rather than airport to airport), belly only cargo carriers, or mixed carriers that operate a fleet of both passenger and freighter aircraft. The discussion below will describe each of these business models.

All cargo

The all-cargo carriers operate a dedicated fleet of freighter aircraft. Some examples of all cargo carriers are Cargolux, Evergreen, Kalitta, Northern Air and Centurion. These carriers seldom deal directly with individual shippers, and instead typically work with intermediaries called freight forwarders. Forwarders consolidate many small shipments from their customers into pallet size loads in essence buying cargo space wholesale from the air carriers and selling retail to their customers. Working with freight forwarders all cargo carriers often will enter into long-term contracts with the forwarders, which provides some stability in demand for carriers. These long-term contracts provide economies of scale for the airlines enabling them to enter into long-term contracts to lower purchasing price and hedge against price uncertainty. However, with over 90% of volume shipped by air organized by intermediaries, the all-cargo carriers are linked closely to the decisions of the freight forwarders.

Belly cargo carriers

Belly cargo carriers are passenger-only airlines that carry cargo in the holds of their aircraft as an additional revenue stream. Between 40 and 50% of global airfreight is moved as belly cargo. Demand for belly cargo is largely driven by the unrelated market demand of passenger air transport making it difficult for airlines to match supply with demand. However for the belly cargo only carriers, since their capacity is fixed and demand is unrelated, fluctuations in supply tend to be less of an issue, and have a low marginal cost.

Integrators (door to door)

The integrators, also known as express carriers are firms that provide door-to-door service such as UPS, FedEx, and DHL. Many of these firms operate dedicated all cargo aircraft, delivery vehicles, and cargo
hubs. The cost for express services are much higher than for other modes of transportation however the express carrier must own and operate the entire transportation network from delivery vehicles to hubs (both ground and air hubs) the dedicated aircraft to move the cargo, receiving air hub and the downstream transportation network to deliver the cargo to its final destination.

Combination carriers

Combination carriers move both passengers and cargo. Like the all-cargo carriers, combination carriers work almost exclusively with freight forwarders to provide the pickup and delivery service to the ultimate customer. Airlines such as Lufthansa, Air France, Cathay Pacific Airways, and Korean air operate fleets of both passenger and dedicated cargo aircraft and therefore considered combination carriers. Combination carriers can earn up to one-half of their gross revenues from cargo on some routes6.

3.4 Current Air Cargo Paradigms

Volatility

If a single word were needed to describe the current air cargo supply chain, one would be hard pressed to find a more accurate word than volatile. In the past we have seen gradual seasonal variations in air cargo with occasional abrupt anomalies that were generally easy to explain with a recovery to normal soon after. Now we see both demand and capacity vary significantly on a month to month and year over year basis as producers, shippers and carriers try to find the dynamic that allows them to all make a profit. Nearly empty airplanes flying around the world simply because they were scheduled are a distant memory. However, diverting cargo to an alternate mode due to insufficient capacity may have long-term negative effects that are also unacceptable. With the rapid dissemination of information in today’s world and the ability to track almost any statistic in near-real time the volatility of the air cargo system is evident. Most of this volatility is absorbed in the dedicated freighter operations. Belly cargo space is available whether or not the aircraft is full since the passenger flight will fly as scheduled. If there is no room for additional cargo, the freighter is needed. If there is room for the cargo in the belly then the freighter is not needed. These decisions may be made late in the game in this “just in time” world. It is unlikely that this volatility will decrease in the foreseeable future. It appears to be the new normal in the air cargo industry.

Security

As if the demand/capacity volatility were not enough of a challenge, the air cargo industry seems to face a myriad of other changing challenges. Security requirements top a long list of challenges that may change rapidly in response to events outside the control of the carriers. The lack of an international standard has made meeting security requirements particularly difficult. Recent collaboration between regulatory agencies in the U.S., Asia and Europe may indicate that while there will always be the need to adapt to new threats, the responses may be more similar than in the past, greatly simplifying the tasks facing the carriers and their customers.

Cargo screening

Cargo screening can be done in many ways. Physical/technology screening, canines, or screening based on the known characteristics of the shipper are all methods currently being used. Until there is a technology that allows screening whole Unit Load Devices (ULDs) or pallets it is unlikely that 100% physical screening will be implemented since that could induce such a burden on the air cargo supply chain as to render it unworkable. Basing the screening on the risk appears to have become an

6 Source Air Transportation, by John Wensveen 2009
acceptable and rational method to allocate resources where needed while allowing commerce to continue.

3.5 Business Models

The existing air cargo business models are not static. They too are changing to meet the requirements of the global economy.

Manufacturing/consumption centers

Global manufacturing centers have been shifting for many years to follow the lowest cost of production (normally wages). This trend seems destined to continue as manufacturing in China shifts to the west and some types of manufacturing move to other less developed countries. What has been less apparent but equally predictable is that as countries develop a middle class with disposable income they will become consumption centers. China is not just the world’s factory but is on its way to becoming the world’s consumption center as well. Parts of North America that currently have depressed economies may once again become centers of production which could impact the air cargo supply chain and the flow of goods internationally. Fortunately this ongoing shift is not an overnight phenomenon and generally provides enough reaction time for all involved.

ACMI and other arrangements

To meet the changing demand needs without investing excess capital in aircraft and crews, many carriers have turned to the Aircraft, Crew, Maintenance and Insurance (ACMI) or other types of aircraft leases. This allows them to increase or decrease their capacity quickly without idling their own aircraft or crews. This does create some confusion at airports that rely on self-reporting for billing purposes as aircraft with the same markings may be flying for different air carriers at the same time. The aircraft and crew providers can operate at a lower margin since they are not bound to any one carrier’s routes or geographic locations and do not have the infrastructure overhead associated with being a cargo carrier. Instead of (or in addition to) being a charter carrier they augment scheduled or mainline carriers as needed.

3.6 Modal Shifts

As previously discussed, cargo may be moved using any of a number of modes each having its own advantages and disadvantages. In today’s economy where profit margins are often thin the mode of transportation has become much more than just a time/cost value item. In many cases shipping goods by surface provides for storage during the trip that minimizes the need to build warehouses. Shipping just enough to start the sales by air with the rest to follow takes into account the fact that not all the product must be available on day one. On the other hand if the goods are being shipped by surface but they are delayed in production, some may have to be shipped by air to meet delivery commitments. The decision as to which mode to use is made more complex if profits are to be maximized. Simply deciding that a class of goods is of high or moderate value and therefore should be shipped respectively by air or surface is no longer acceptable. In fact some multimodal shipping companies such as Lynden Air Cargo now offer “pay for the speed you need” services within their own company with the ability to combine modes as needed without involving other entities.
3.7 Alliances

One trend that is not new but has received a great deal of attention lately is air carrier alliances. So far this has had much more impact on the passenger service than on the cargo service but the potential may exist for a business opportunity due to alliances. As air freedom rights and bilateral agreements continue to expand there may be a time when alliances allow for code sharing that meets or exceeds what we see on the passenger side. It should be noted that these alliances may have a very strong impact.

3.8 Online verses Brick and Mortar

Much has been written in the last ten years about the impact of online shopping on traditional brick and mortar stores. One area where the impact has been seen is in the air cargo industry, instead of shipping large quantities of goods to several stores around the country, now we see individual units being shipped to hundreds of thousands of individual addresses of the end users. This has often meant lighter loads on the aircraft since each unit must be packed for shipment. It has also caused a need for additional sort facilities to prevent unnecessary transporting of each unit. While many had predicted the demise of the traditional store and there has certainly been a negative impact on smaller operations, large retailers such as Wal-Mart have simply gone online themselves and taken advantage of the business opportunity that technology has offered.

3.9 Decisions and control

One key aspect of the air cargo supply chain is that while air carriers may provide the transportation, they are often not in charge of the goods being transported. As previously discussed there are many different business models ranging from those of the integrated carriers such as UPS and FedEx to the on-demand charter carriers. Even well-known and established flag carriers may be carrying cargo that they are simply the “truck driver” for. In many current business models, the freight forwarder or master shipper has already purchased the space and is responsible for filling it. He assumes the risk which is beneficial to the carriers but he can also shop around among the carriers since he and his customers may have no significant loyalty to any one carrier. That means he can drive a deal that favors his client in exchange for assuming the risk of filling the aircraft. Some carriers are realizing that the profits often go with the risks and are tentatively looking at expanding their business model to be more like FedEx and UPS, controlling the shipment from door to door or from factory to door.

3.10 Regulatory

The regulatory environment is one of the biggest uncertainties facing the air cargo industry. Security, safety and environmental regulations may be changed rather quickly and the economic impact to the supply chain is often not considered.

3.11 Environmental

Airport professionals are familiar with noise regulations and efforts to minimize or mitigate the impact of noise on those that live near airports. Recently a number of other environmental issues have emerged that may significantly impact the industry. Emissions regulations as enacted in Europe may cause a significant increase in the cost of shipping goods by air. At the same time, US imposed regulations requiring the use of ultra-low sulfur diesel in ships within 200 miles of the US coast may cause a similar increase in the cost of some international surface transportation. Imposing restrictions without considering the consequences is seldom a good plan. Studying how to minimize emissions through
better fuel economy to reduce operating costs is an area of common interest to both economics and environmental constituencies.

3.12 Freedom Rights

The world is becoming more interactive and national borders are often blurred by business. The expansion of air freedom rights and the ever increasing number and type of bilateral agreements allowing carriers to operate more efficiently bodes well for the future of the air cargo industry. There does not appear to be any reason to expect these types of agreements to do anything but continue to increase.

3.14 Air Cargo Trends

*Geography*

Production will almost certainly follow the lowest costs and those will generally be driven by wages. Wages in eastern China are pushing manufacturing west. Production is also moving south into southern Asia as well as further west into India. In the future there is little reason to think that shifts will not continue. Emerging countries in Latin America and Africa are looking to capitalize on their capabilities. If this happens the air cargo industry will simply have to shift with the production and consumption centers as they move. One model that might become more common is that of Cargolux who flies around the world always heading eastward moving cargo from one part of the world to another. While this may currently be a niche business model it may also have more potential as the markets shift.

*Turmoil*

One constraint on the future of shifting markets as well as current markets is lack of governmental and civil stability. Few carriers are interested in operating in areas where there is ongoing unrest, war or a high likelihood of conflict. Countries that hope to attract air cargo business must demonstrate that they can provide stable, safe airports and transportation infrastructure.

3.15 Air Cargo Future Perspective

The Air Cargo market, like the stock markets, is very difficult to forecast given the many variables and factors involved in air freight trends. The air cargo industry is continually adapting to threats and opportunities. The primary driver for air cargo growth is global economic activity which is determined and measured by the World GDP. Currently, the GDP growth is relatively flat which is due to high unemployment in developed economies and weakened and strained consumer purchasing. In the next 20 years, the world economic growth is forecasted to average around 3.2%. Air cargo is anticipated to grow at an annual rate of 5.2% and be a critical component of supply chains both domestic and international, especially in emerging markets which will connect established economies with developing regions. These are markets where population migration and growth in the middle class have created a strong demand for food and perishable commodities, which will substantially increase in volume and tonnage. The Boeing Forecast indicates that over the next 20 years, air cargo traffic is expected to double globally which in turn will create a demand to expand freighter fleets to approximately 3,200 airplanes. The largest growth market segment will be larger aircraft with payload lift capabilities of 80+ tons as traffic builds on long-haul international trade routes.

A number of factors will have an impact on air cargo growth and pose global challenges in the air cargo industry and effect sustainability. Those challenges that are the most critical as air cargo grows into the
future are geographical modal shifts, fuel costs, environmental policies, security, and technology advances both in equipment and information.

![World air cargo traffic will more than double over the next 20 years](image)

3.16 Aircraft and Freighter Fleets

Freighter fleets currently account for about 10% of the total airplane fleets operating globally. As air cargo volume and traffic levels triple over the next two decades, the preference among airlines and shippers will be a shift toward wide body freighters which will increase the average payload per aircraft. This increase in payload capacity will account for the difference between demand growth for cargo services and growth of freighter fleets. By 2031, 36% of freighter fleets will be comprised of large category wide body aircraft which is an expansion from the current wide body aircraft share of 31%. Over half of all additions to cargo fleets will be in the medium / large freighter market, which has capacities of 40 tons+ per aircraft. Of the freighter fleet additions, 70 percent will come from modified aircraft and 30 percent of airplanes will be new production large freighters with 80+ tons capacity per aircraft. New production aircraft provide many benefits to the airlines and operators such as technical advantages, reliability, fuel efficiency and overall low operating costs.
3.17 New Aircraft Technology

Enhancements in aircraft manufacturing technology over the past decade have afforded direct benefit to operators looking for fuel efficient aircraft with greater payloads. For example, the new 747-8Fs from Boeing offer unprecedented value for their customers. In comparing the new 747-8Fs to the 747-400F, the customer is now offered a maximum payload up to 140 tons. This translates to 16% more revenue-cargo volume per flight and a decrease of 15% in ton-mile costs to operate. New technology aircraft such as the 747-8F is more fuel efficient while environmentally offering a 16% reduction in carbon emissions and an increased range of 1,000 nautical miles.\(^7\)

Airbus’ freighter is one of the world’s largest carriers. The “Beluga” is an A300-600ST and there are currently five in the Airbus fleet. This aircraft, which resembles a whale, is also known as the Super Transporter and offers one of the widest fuselage sections of any aircraft and is tailored to transport heavy and oversize cargo with payloads up to 47 tons. Although not offering the largest tonnage payload, its benefit is the ability to handle very large pieces such as airplane fuselages and aircraft wings as well.

\(^7\) Source: Boeing
as space station modules and large satellites. Along with performing regular airlift flights for Airbus, this aircraft is also available for chartered commercial projects.

The technology improvements include the airframes, which incorporate composites and other advanced materials which result in significant weight savings. State of the art technologies are also found in new-generation cockpits which offer the latest interactive displays and avionics. These advances ensure optimum handling conditions which improve overall efficiencies of the aircraft. All of these advantages offer the airlines and cargo operator’s better efficiencies as fuel and other operating costs increase.

3.18 Cargo Airships

Nearly 75 years after the Hindenburg explosion, there is a revival of interest in hybrid airships being explored by a new generation of entrepreneurs. This group is looking to develop a new alternative low carbon future for air cargo. Far safer than the airships of the past, these contemplated future airships are a hybrid of fixed wing and lighter than air aircraft with 40 percent of the aircraft filled with helium. With the ability to carry payloads of 50 tons and not reliant on tarmacs, runways, airports or roads, the airships offer the ability to bring large cargo loads to specific project sites at a fraction of the fuel and cost of traditional aircraft. With the anticipated cargo growth in developing markets such as China, Africa, South America, and other regions where transportation infrastructure is limited, the future of Cargo Airships is beginning to look better.

There are currently a handful of companies that have prototypes under research and development where they envision a vast potential market. Recently as of 10 years ago, there was an aggressive approach by the Germany based CargoLifter AG that also had similar predictions for this market and invested around $500 million into their product without ever building a prototype. But the technology in the past 10 years has much improved as the need for ground infrastructure is no longer required for cargo to be offloaded. This was one of the major issues with the CargoLifter as its operation required considerable facilities on the ground to deliver and offload cargo. In the future, it is estimated that airships will be able to operate without ground infrastructure, reduce or completely eliminate trans-shipment issues and save up to 75 percent of fuel. At the same time, they will be able to pick-up and deliver heavy payloads to remote areas anywhere in the world regardless of infrastructure restrictions. This benefit is enormous for oil exploration, humanitarian relief operations and other remotely located industries that rely on air cargo.
One of the drawbacks of airships would be the slow speeds in transporting goods from continent to continent compared to fixed-wing freighters, but the airships reduce greenhouse gas emissions by up to 90 percent. As the research and development continues to build momentum for cargo airships, expect to see them in the near future with substantially larger payloads.

### 3.19 Bio-Fuels

Just a few years ago, the concept of using biofuels to power commercial airliners was beyond the scope of modern science. But as of today it is a reality and becoming an increasing source of jet fuels moving into the future. The benefits of bio-fuels are the friendly environmental impact they provide as well as the creation of fueling options. Bio-fuels were introduced in early test flights of 2008. In August 2011, Aeromexico completed the first intercontinental bio-fuel flight from Mexico City to Madrid. The aircraft was a Boeing 777-200ER and operated on a 30% blend of bio-fuel. Since then, there have been other flights utilizing a variety of bio-fuel blends. For the year 2015, the bio-fuel community has set a goal of having 1% of all aviation fuel to include bio-fuel content. Once that is achieved, the usage will begin to increase exponentially to 5% then 10% as the learning curve improves.

The current challenges facing the industry are making bio-fuels economically feasible while at the same time achieving a 50 percent life cycle reduction in greenhouse gas emissions. But as the future unfolds, this new fuel source will compete with petroleum to become a viable fuel source for commercial aircraft. It will also help maintain traditional fuel resources and reduce cost volatility while supporting environmental issues.

### 3.20 Airports of the Future

Airports of the future are being built now and are becoming key factors in global production and shifts in cargo flows. They are focused on creating a passenger experience by providing a local and regional flare to their environment to stimulate the shopping and airport experience. With the advent of the Airbus 380, terminals at select gateways are being rebuilt and configured to handle the double decker aircraft and have subsequently expanded concourses and airport terminals. Airports are powerful entities of local and

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9 Source: [www.greenaironline.com](http://www.greenaironline.com)
regional development attracting aviation related business such as time-sensitive manufacturing, distribution facilities along with corporate relocations and all facets of retail, hospitality and entertainment. Airports are evolving from a collection of facilities that move people and products via air, into complex and dynamic airport cities. This accelerates property demand from importers and exporters who want increased access to cargo flights and site locations for their companies and facilities on or near airports. The future of airports is now in many cases tied to regional urban planning and infrastructure development with a full focus on how to fully take advantage of airport area development. Infrastructure links such as trains and expressways should efficiently connect airports to major business, industrial and residential areas. Clusters are developing to separate manufacturing, warehousing and trucking functions from office complexes and residential development so as to improve the flow of goods and airport passengers. For all the planning to be effective, airport planners and local and regional governments must work together in order to sustain intelligent development.

As areas grow and develop around airports, land availability becomes a valuable asset for any airport. With the exception of new airports that tend to be built away from city centers and population, most airports are constrained with limited land available for development and infrastructure expansion projects. A few mature airports had both the vision (and property) for growth and expansion when they were built. Today those airports are driving regional growth and development and have themselves, undeveloped land ready for expansion and cargo development.

Airports of the future are basically categorized into three types: Gateway Airports serving the global international passenger business, short haul domestic and low-cost airports that cater to their travelling passengers, and a limited number of cargo airports that are focused almost entirely on serving the integrators and all cargo carriers. Cargo Airports are operating on relatively lower costs since they do not have to absorb the cost of passenger facilities in their landing fees and other fees tied to passenger flights.

- Many airports have put a focus on developing cargo activities through capital improvement projects at their respective airports, which in turn attract all cargo freighters and integrators. An airport’s air cargo classification falls into one of four distinct types of functions: local market station, air cargo hub, international gateway and intercontinental hub.

- Local market stations are airports that offer origin and destination services. This type of airport is generally passenger driven and consists primarily of belly cargo services that depend on the local market and surrounding catchment area. This airport represents the spoke in a hub & spoke model of an air cargo network.

- An Air Cargo Hub airport does not depend on local markets for cargo origin and destination, and acts as more of a transit facility. The facility serves basically as a sort facility and gateway, versus an airport which services the local market. The key decision factor in locating the operation is proximity to population and industrial centers.

- International Gateway airports are very similar to an air cargo hub in that they are not dependent on the surrounding market to generate tonnage to support the operations. This type of gateway functions as a consolidation, distribution and processing center for international air cargo. The primary driver for selection of an international gateway is wide body lift to international destinations. This lift is provided by commercial wide body aircraft, express integrators and all cargo carriers that offer scheduled or chartered services.
An intercontinental hub airport connects continents together by air cargo and passenger aircraft. This facility is typically situated in remote parts of the world and offers aircraft service centers and specialized services such as a fueling and crew changes.

For airports to target their growth, they need to determine how they want to position themselves and grow their cargo business accordingly. Air cargo carriers use a wide variety of criteria in selecting and locating air cargo facilities and planning their network. Much depends on the operational, financial and strategic objectives of the carrier and how they align themselves with various airports.

The majority of commercial Airports are owned and operated by local and state governments and airlines are dependent on these groups for adequate facilities and capacity to expand and grow, while at the same time functioning at a reasonable cost. Airlines also incur costs which are imposed on them from the FAA through various regulatory requirements. Airline operations and business decisions are affected by changes in federal law and actions taken by governmental agencies. These laws and actions vary per country and city but a major issue is the adoption of more restrictive policies imposed on local noise regulations and night flight restrictions. These policies and changes in law have a direct effect on certain cargo operators flying at specific airports that impose this restriction. This will cause a shift in freighter networks to airports that offer fewer restrictions that better fit flight schedules and routing connections for cargo flights. As air traffic continues to grow and airports expand, night flight restrictions, which aim to reduce noise impacts at airports, will continue to be popular.

NextGen, or the Next Generation Air Transportation System, is a new National Airspace System that is currently rolling implementation across the United States with full functionality to be around 2025. NextGen is transforming the air traffic control system to a satellite based system from its current antiquated ground based system. This transformation is intended to reduce airspace congestion and airside traffic at the airports. The expected growth of operations is the driver behind NextGen to help airports accommodate the demand for capacity in a safe, efficient, and environmentally friendly manner. NextGen, as envisioned will totally revamp the current system and result in shortened flight routes, reduced fuel burn, time-savings, fewer traffic delays, increased capacity and better-managed airspace. The net result is greater safety and potential savings in the billions. With the expected reduction in aviation fuel usage, emissions will be drastically reduced to support the environment. When fully implemented, NextGen will have the ability to offer pilots and flight dispatchers the option to select their own flight paths and aircraft will be equipped to inform pilots of their exact location in relation to other aircraft in the area, providing increased safety in the sky.

3.21 E-Freight

E-freight is expected to become the booking process for freight forwarders for their shipments with the airlines. International airfreight shipments can require more than 30 different paper documents, which annually is more than 7,800 tons of paper documents. E-freight goals are to eliminate paper out of the air cargo supply chain and replace it with economically reliable electronic messaging and bookings. This initiative is industry wide and involves all parties such as freight forwarders, ground handlers, shippers, customs authorities and airlines. The current targets are to achieve 15 percent eAWB (Air Way Bill) usage globally and to expand the usage and availability globally. Moving into the future, the ultimate goal is to reach 100 percent compliance by 2015 with e-freight. This concept was started by IATA and is now an industry-wide initiative. The approach is international in scope as countries must first pass a high level assessment and a detailed level assessment to be certified. The benefits are lower costs and annual savings in the billions for the industry, along with the ability to accelerate supply chain transit times by 24 hours. Another key benefit is the reduction in delays that are currently caused by inaccurate or inconsistent data entry or delays caused by missing documents. As the industry becomes more
constrained by compliance issues, e-freight will be able to offer regulatory compliance and meet all guidelines both international and local relating to the documents and data required by customs and other regulatory authorities.

As with any type of initiative as large as this project, there will always be challenges to face. The main issue in the freight forwarding community is the lack of IT solutions for the small-midsize forwarders. The cost of investment combined with a lack of financial incentives is also an issue. There are also legal and political considerations that must be addressed to ensure global participation and buy-in. On a more pragmatic level, the different approaches to cargo interdiction and facilitation taken by Customs operations in various nations, complicates full acceptance.

3.22 RFID and Tracking Cargo into the Future

Radio Frequency Identification (RFID) opportunities and benefits are widely known in tracking cargo shipments. In the airline cargo industry, RFID improves asset utilization and improve system efficiencies, however, the implementation of this technology is dampened by infrastructure, hardware and software development costs. The infrastructure needs to be shared and integrated efficiently in order to realize a return on investment from this type of solution. Which standard is to be adopted by the airlines and forwarders to make it a true encompassing global system for air cargo remains a question? Besides the ability to track cargo shipments and improve asset utilizations, security processes in the supply chain will improve. It is important for regulators to allow RFID on aircraft for the system to be most effective. Finally, infrastructure and technology costs must come down to realize widespread use and feasibility for the entire air cargo industry.

10 Source: IATA