CHAPTER 1

AIR FREIGHT – HISTORICAL PERSPECTIVE, INDUSTRY BACKGROUND AND KEY TRENDS

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1.1 Introduction

What is air freight? Air freight/cargo can be defined as all cargo moved by air except for mail and passenger baggage. The two options for air cargo transport are dedicated freighters and belly capacity in passenger aircraft. Air freight accounts for about 1 percent of total freight by weight transported worldwide, but some 35 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, there is 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 transportation mode offers different costs and benefits. 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. However, first a little history.

1.2 History of Air Cargo

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 started, 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 have 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 between 1942 and 1945. Later, between 1948 and 1949, the largest airlift in history occurred to support the blockaded city of Berlin, Germany.

In the early 1970's 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 1011. In the beginning, only the passenger market was serviced by these new wide-bodied aircraft until the first Boeing 747 freighter was flown between Frankfurt and New York in April 1972 by Lufthansa. The much larger wide-body aircraft represented an increase the volumes carried by narrow body aircraft by a factor of almost 3.

In 2018, there were 1870 freighters in operation worldwide. Thirty- percent of these were large wide body (>80 tons) aircraft, 33% where medium wide-bodied aircraft (40 to 80 tons) and 37% were standard bodies with carrying capacities of less than 45 tons. Boeing projects the demand for the world freighter fleet to increase to 3260 airplanes by 2037. This expected demand will be met through new freighters and conversion of passenger airlines to cargo aircraft.

1.3 Airline Industry Deregulation

In 2018, the 40-year anniversary of passenger air carrier deregulation in the U.S. was marked. Often, people forget that freer movement of air cargo was actually implemented 1 year earlier, in 1977. This was the *enabler* for companies like FedEx to use overnight shipping over any route rather than depending on limited belly space via passenger aircraft. The benefits became apparent for concepts including *just in time* shipments, investment in accurate tracking systems and, of course, today's e-commerce.

U.S./Canada deregulation has been part of a greater global airline liberalization trend, especially in Asia, Latin America, and the European Union.

Network industries, which are critical to a modern economy, include air travel, railroads, electrical power, and telecommunications. After deregulation, the passenger airlines quickly moved to a hub-and-spoke system, whereby an airline selected some airport (the hub) as the destination point for flights from a number of origination cities (the spokes). Because the size of the planes used varied according to the travel on that spoke, and since hubs allowed passenger travel to be consolidated in *transfer stations*, capacity utilization (*load factors*) increased, allowing fare reduction. The hub-and-spoke model survives among the legacy carriers, but the Low Cost Carriers (LCCs)—about 28 percent of the world passenger market—typically fly point to point. The network hubs model offers consumers more convenience for routes, but point-to-point routes have proven less costly for airlines to implement. Over time, the legacy carriers and the LCCs will likely use some combination of point-to-point and network hubs to capture both economies of scope and pricing advantages.

Open Skies agreements (discussed in greater detail in Chapter 6) are bilateral agreements between the United States/Canada and other countries to open the aviation market to foreign access and remove barriers to competition. They give airlines the right to operate air services from any point in the United States/Canada to any point in the other country, as well as to and from third countries. Open Skies agreements have been successful at removing many of the barriers to competition and allowing airlines to have foreign partners, access to international routes to and from their home countries, and freedom from many traditional forms of economic regulation. A global industry would work better with a globally minded set of rules that would allow airlines from one country (or investors of any sort) to establish airlines in another country (the right of establishment) and to operate domestic services in the territory of another

country (cabotage). However, these agreements still fail to approximate the freedoms that most industries have when competing in other global markets.

The air cargo industry has directly benefited from the environments created by airline deregulation and further liberalization of international trade agreements. These changes have helped to create a global, interconnected economy where the efficient movement of goods by air is not only convenient for consumers, but critical to today's business models.

2. AIR CARGO INDUSTRY BACKGROUND

2.1 Benefits of Air Cargo

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, these 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 smaller in size and weight.

Time sensitivity

Certain products are extremely time sensitive. These could include a wide range of perishables, medical products, and seasonal products that must meet very specific delivery deadlines and whose production offers limited options other than by air.

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 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 select 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.

2.2 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 and industry. 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. The speed of air transport allows companies to reduce their capital tied up in in-transit inventory and provides for greater security.

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. More recently, pharmaceutical products have become a major element in air cargo growth.

Demand predictability

The more predictable the demand for a particular product is 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 rail heads. 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 airfreight, 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 transportation 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. Pricing on containerships is 10 to 20 times cheaper (by weight) then shipping goods by aircraft. In addition, containership capacity, with enhanced refrigeration and climate control amenities, continues to grow, improving the reliability issues and reducing transit time of good shipped. These two factors are putting pressure on the air cargo industry.

On a final note, keep in mind that “just in time” manufacturing does not immediately imply the involvement of air shipments. All it means is that the production of a product will be timed to allow for the optimum transport mode to deliver the product to the consignee at the designated delivery date and time.

2.3 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. It is business worth pursuing. Sourced from published IATA findings, total North American GDP supported by aviation was $844 billion in 2017, part of which comprised 19.2 million metric tons of air freight. 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 and Atlas Air. 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, which provides some stability in demand. These long-term contracts provide economies of scale for the airlines enabling them to lower purchasing price and hedge against price uncertainty. *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. Belly cargo is largely accommodated by the unrelated market demand of passenger air transport making it difficult for airlines to match supply and capacity 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, but can provide welcome incremental revenue to increase profitability on marginal flights.

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. E-commerce has exploded since the last revision of this guide, driven by now familiar names like Alibaba and Amazon. SF Express and Amazon Air have fleets of freighters of 50 aircraft each, astonishing growth in a small period of time. Many of these firms operate dedicated all cargo aircraft, delivery vehicles, and cargo hubs. The cost for express services is much higher than for other modes of transportation. This is because the express carrier typically owns and operates the entire transportation network from aircraft and delivery vehicles to hubs (both ground and air) and the downstream transportation network to deliver the cargo to its final destination.

Combination carriers

Combination carriers fly both passenger and freighter aircraft. 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, KLM/Air France, Cathay Pacific Airways, and Korean Air operate fleets of both passenger and dedicated cargo aircraft and are therefore considered combination carriers. Combination carriers can earn up to one-half of their gross revenues from cargo on some routes.

3. KEY TRENDS IN AIR CARGO

3.1 E-commerce Growth

The explosive growth of e-commerce over the last 10 years has greatly increased the demand for air cargo. This demand is projected to grow at 20 percent over the next five years. This high level of activity in e-commerce has provided the integrated express carriers with a faster growth rate than the overall air cargo growth rate. The integrated express carriers grew at a rate of 11.5 percent in 2017, whereas the world air cargo traffic grew 10 percent. Of course, this type of growth signals opportunity which often leads to new entrants. In the case of e-commerce, the new entrant challenging FedEx and UPS is Amazon Air. Amazon's deep pockets and proven ability to innovate has led to an impressive nationwide network of

markets served by contracted freighter aircraft carrying Amazon packages. In 2019, it is clear that we are still in the early chapters of the e-commerce story and its impacts on air cargo, but so far, the impact has clearly been positive and resulted in a larger market for the industry's services.

3.2 Non-traditional Cargo Airports

Air cargo activity in North America has long been dominated by major international gateway airports such as New York (JFK), Los Angeles (LAX), Chicago (ORD), Miami (MIA) and Toronto (YYZ) as well as integrator hubs like Memphis (MEM) and Louisville (SDF). In recent years, airports that were previously not known for large cargo operations have experienced tremendous growth.

Much of this growth is due to e-commerce and the expansion of Amazon Air. Now, non-traditional cargo airports like Lehigh Valley (ABE), Baltimore-Washington (BWI) and Charlotte (CLT) are handling thousands of annual operations by Amazon Air. Airports like these, are relatively free of congestion and located near consumers who demand the speed and convenience of e-commerce. This development in the North American air cargo industry is truly transformational. Prior to Amazon Air, the large, but mature U.S. domestic air cargo market had been led by the duopoly of FedEx and UPS (with participation to a lesser extent by DHL). As Amazon Air and, potentially, other new cargo airlines build their networks to accommodate e-commerce volumes, it is likely that even more non-traditional cargo airports will see their freighter operations grow exponentially.

Growth at non-traditional cargo airports has not been limited to e-commerce activity. General freight has led to new international freighter services at airports like Greenville-Spartanburg (GSP) and Pittsburgh (PIT). In many cases, carefully crafted niche strategies help attract freighter services to airports that are not large gateways. Typically, these strategies involve elements such as financial incentives, promises of low airport costs and no airside or landside congestion, and large local shippers committing to use the airport's new freighter services. While these non-traditional cargo airports may never challenge the major gateway airports in terms of total tonnage, it is increasingly evident that smaller, non-gateway airports can effectively serve certain segments of the air cargo market.

3.3 Belly Cargo

Cargo is transported by airlines in two primary ways – via dedicated all-cargo freighter aircraft and via the bellies of passenger aircraft. While freighter aircraft carry the majority of air cargo worldwide, the continued growth of passenger air services has naturally led to more belly capacity available for cargo. Widebody aircraft are particularly suited for carrying cargo because they accommodate containers and pallets which makes loading and unloading much more efficient. Further, because belly space is a by-product of passenger service, it is often marginally priced and, therefore, can be an economical alternative for many shippers. Cargo adds important revenue streams to passenger services and many airline managers will concede that cargo is often the difference between profitable and unprofitable international routes. New aircraft such as the B787 and the A350 include specific design elements which maximize their cargo carrying capabilities. Not only are these aircraft cargo-friendly, they are increasingly being deployed on long, thin routes where nonstop passenger services could never have been offered before. Thus, international routes that started with new technology aircraft like Austin, Texas - London and Charleston, South Carolina – London benefit through direct passenger service as well as attractive belly cargo service.

3.4 Temperature Controlled Goods – Perishable Foods and Pharmaceuticals

As noted in Section 2, air cargo is particularly useful when perishability is an issue and where strict temperature controls are required. Accordingly, air cargo is being employed more in the transportation of items such as fresh foods and pharmaceuticals.

In recent years, demand for fresh foods has been on the rise in developed countries. This is driven not only by trends toward healthier lifestyles, but also by population increases and higher personal incomes. Along with improved supply chains and innovative technologies, air cargo has been effective in serving the growing market for fresh food. This has included the development of specialized shipping containers, real-time temperature monitoring devices and purpose-built air cargo facilities. Further, fresh food deliveries to individual consumer addresses via e-commerce channels has brought more investment into the sector and more demand for air cargo services.

The healthcare needs of an aging global population are also driving air cargo demand leading to additional requirements by users. Early in the 21st century it was becoming apparent that air cargo was losing significant market share in the international carriage of pharmaceuticals to the ocean carriers, primarily due to poor temperature control over the various sectors of our cool chain. Brussels Airport recognized this and initiated a commitment to pharma quality with their airline and handling partners. Successful development drove an evolution of process and standards which was recognized and adopted by IATA. Certification is now offered globally by IATA, with over 160 companies certified at different locations.

Some of ACI-NA's member airports in the U.S. and Canada are among those certified or going through the process. The certification process is arduous and expensive but is a "tool" which can be valuable presuming there is a fit with either your current or prospective air carrier customer base. If nothing else, it is a tremendous opportunity to get involved with the key components of your airport community.

3.5 Global Trade

Liberalization of transportation and other regulations has enabled global trade to proliferate. Open skies, airline alliances and relaxed airline ownership rules have benefited the air cargo industry by providing better access to markets while allowing for economies of scale. In recent years, some world leaders have questioned the value of globalization citing negative impacts on employment and economies in their home countries. In North America, the North American Free Trade Agreement (NAFTA) was renegotiated in 2018 leading to the United States-Mexico-Canada Agreement (USMCA). The United States and other countries have also imposed sanctions and tariffs on selected countries and industries to achieve a stated goal of ending unfair trade practices.

While the appropriateness and necessity of these changes to international trade agreements can be debated, there are certainly impacts to the air cargo industry – especially if the new trade environments lead to protectionist regimes. The ongoing experiences between the United Kingdom and the European Union over Brexit are an indication of the complexity and potential negative consequences of unwinding decades-old international trade agreements. From an air cargo perspective, any restrictions to global trade will likely be viewed negatively with the specific consequences being unknown, but undoubtedly far-reaching.

3.6 Emerging Technology: Blockchain

Blockchain is a secure decentralized peer-to-peer network where all of the stakeholders can view and share data. Think of it as a type of database. Unlike legacy Electronic Data Interchange (EDI) systems that are

centralized, therefore giving power to the owner of the data, blockchain is decentralized. Blockchain verifies transactions and provides a history of transactions to ensure that the data has not been altered. Therefore, Blockchain technology can be used to send secure digital documentation (such as air waybills, and letters of credit). The benefits of block chain technology are the elimination of redundant data and enhanced visibility and transparency for all stakeholders. In addition, the data stored in blockchains can be used to provide real time analytics.

The use and applicability of blockchains with aviation is still being hotly debated. In addition to the obvious benefits of being able to send and secure digital documents blockchains could also be used in maintenance operations to digitize maintenance logs, provide an unbroken chain of every part on an aircraft and provide traceability of who handled the part.

There are high expectations on the possible uses of blockchain but there are still many unanswered questions.

3.7 Emerging Technology: Drones

Advancements in Unmanned Aerial Vehicle (i.e. drone) technology have natural applications to the air cargo industry. Transporting products and packages via drones clearly entails less risk than transporting people and there are immediate commercial applications in the form of e-commerce shipments. Companies like Amazon, Alphabet (Google's parent company), China's JD.com and numerous start-ups are currently developing and testing drones. These companies are particularly optimistic that using drone technology in remote locations and urban environments can help overcome infrastructure constraints which challenge efficient deliveries. Governments in North America continue to grapple with the appropriate form of regulating this burgeoning industry, but this appears to be a temporary obstacle – especially as other countries already allow liberal use of drones. In Spring 2019, Alphabet's Wings Aviation division received the first U.S. authorization to operate a fleet of drones for consumer-goods deliveries, starting in a rural area of Virginia. For larger metropolitan areas, there are obvious air space issues. However, this is surely the first of many approvals by the FAA of drones used for deliveries, thereby paving the way for future innovation and growth.